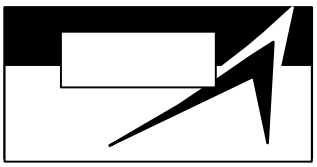
SSP 50146, Revision A

NASA/RSA BILATERAL S&MA PROCESS
REQUIREMENTS FOR INTERNATIONAL SPACE STATION

International Space Station Program

Revision A

October 1, 1998



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PREFACE

ISS Program requirements for hardware and software safety and mission assurance requirements are defined and controlled in this document. This document establishes the applicable requirements for Safety, Reliability, Maintainability, and Quality Assurance between NASA and RSA.

In the implementation of safety and mission assurance requirements, consideration shall be given to criticality, complexity, state of hardware and software development, and unit and life cycle cost. The methods for implementing these requirements will be described in the respective Safety and Mission Assurance Plan (S&MA) from RSA.

This document is under the control of the Space Station Control Board (SSCB), and any changes or revisions will be approved by the Deputy Director.

NASA/RSA BILATERAL S&MA PROCESS REQUIREMENTS FOR ISS APPROVAL

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NASA/RSA

INTERNATIONAL SPACE STATION PROGRAM

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1.0 INTRODUCTION

1.1 PURPOSE

This bilateral process agreement establishes specific roles and responsibilities that implement the interim agreement, establishes the ISS programmatic hardware and software safety and mission assurance requirements and defines the information and data exchanges which will allow NASA and RSA to conduct joint tasks successfully. This agreement is intended to be consistent with higher level agreements made in the Interim Agreement, the Joint Management Plan (JMP), and the Memorandum of Understanding (MOU).

1.2 SCOPE

Requirements defined in this agreement apply to all ISS elements developed by RSA and NASA, with respect to critical functions, as well as hardware and operations that may result in catastrophic hazards and/or crew injury in the event of an Off-Nominal Situation (ONS).

Where a reduced scope is applicable to Russian Transport Vehicles (Soyuz TM and Progress M , and Logistics Transfer Vehicle(LTV)) it is specifically delineated in the appropriate sections of this document.

1.3 GENERAL

1.3.1 NASA AND RSA ROLES AND RESPONSIBILITIES

Overall roles and responsibilities in the S&MA area are established in Article 4 of the Interim Agreement between NASA and RSA which states the following:

4.1 In order to assure safety, NASA has the responsibility, working with the RSA and the Cooperating Agencies of the Space Station Partners, to establish overall Space Station safety and mission assurance requirements and plans.

4.2 RSA will develop detailed safety and mission assurance requirements and plans, using its own requirements for its Space Station hardware and software. Such requirements and plans must meet of exceed the overall Space Station safety requirements and plans. Requirements for which meet of exceed criteria are not appropriate will be determined by agreement of the Parties. RSA will have the responsibility to implement Space Station safety and mission assurance requirements and plans with respect to the elements and payloads it provides throughout the lifetime of the program, and to certify that such requirements and plans have been met. NASA will have the overall responsibility to certify that all Space Station elements and payloads are safe.

4.3 The Parties will support and exchange information necessary in order to conduct system safety reviews. The Parties will also conduct safety reviews of the elements and payloads they provide.

1.3.2 NASA AND RSA MANAGEMENT APPROACH

NASA and RSA management of S&MA shall include the following:

1.3.2.A Defining the major hardware and software safety and mission assurance tasks and assuring that they are performed as integral parts of all phases of the program

1.3.2.B Evaluating the safety, reliability, maintainability, and quality of hardware, software, and operations through analyses, tests, reviews, and assessments

1.3.2.C Providing timely status reporting through periodic project reviews and as a part of overall project status reports

1.3.2.D Ensuring compatible safety and mission assurance requirements among manufacturing, test, launch, and ground operations sites

1.3.2.E NASA shall assure that the results of the S&MA analysis on Russian Segment (RS) design conducted by RSA are integrated into ISS assessments activities.

1.3.3 SAFETY AND MISSION ASSURANCE PLAN

A safety and Mission Assurance (S&MA) plan shall be prepared by RSA and NASA. This plan shall define the tasks and products of the Safety, Reliability, Maintainability, and Quality Assurance activities of the Russian and U. S. Segments and the organizational responsibilities for task implementation. The S&MA Plans shall be prepared in accordance with DID R-10-S01 and DID U-10-S08~~1~~ for RSA and NASA, respectively. ~~(Data Item Descriptions are included in Attachment B).~~

1.4 RELATION TO OTHER PROGRAM REQUIREMENTS

1.4.1 PROGRAM REQUIREMENTS

The S&MA analytical and verification requirements set forth in this document shall take precedence in cases of conflict with requirements contained in sub tier documents. The RS S&MA design requirements are contained in SSP 41163, RS Specification International Space Station Program and the US S&MA design requirements are contained in SSP 41162, USOS Specification International Space Station Program. ISS components provided by RSA to NASA under the contract NAS 15-10110 may be covered by additional S&MA requirements stipulated by the contract.

1.4.2 GSE

1.4.2.A RS GSE hardware and software used at other than Russian ground sites shall be subject to the S&MA requirements of those facilities.

1.4.2.B USOS GSE hardware and software used at other than US ground sites shall be subject to the S&MA requirements of those facilities.

1.5 INDEPENDENT EVALUATIONS FOR NASA OR RSA

NASA and the RSA reserve the right to appoint independent representatives to assist in safety and mission assurance evaluation activities. These representatives will provide technical support to the applicable parent organization and determine effectiveness of and recommend improvements for S&MA activities.

1.6 DATA ITEM DESCRIPTION (DID)

DIDs which define the applicable S&MA documentation requirements for Russian and U. S. Segments elements shall be contained in SSP 50137, NASA/RSA Bilateral Data Exchange Agreement and in Attachment B of this document. ~~as well as referenced in the NASA/RSA Bilateral Data Exchange Agreement.~~

1.7 MILESTONE REVIEWS

NASA and RSA S&MA activities shall include supporting internal and supplier design reviews, and ISS Program design and readiness reviews. Participation in milestone reviews shall assure that S&MA requirements are adequately considered.

1.8 REFERENCE DOCUMENTS

The following documents are reference documents that are invoked to the extent specified in the text of this document.

NSTS 13830B Implementation Procedure for NSTS Payloads System Safety Requirements

NSTS 1700.7B Safety Policy and Requirements for Payloads using the Space Transportation System

SSP 30223 Problem Reporting and Corrective Action System Requirements for the Space Station Program

SSP 30233 Space Station Requirements for Materials and Processes

SSP 30234 Instructions for Preparation of FMEA and CIL for Space Station

SSP 30309 Safety Analysis and Risk Assessment Requirements Document

SSP 30459 International Space Station Interface Control Plan

SSP 30599 Safety Review Process

SSP 41000 System Specification for the International Space Station

SSP 41162 United States On-orbit Segment Specification

SSP 41163 Russian Segment Specification

SSP 41170 Configuration Management Requirements

SSP 50021 Safety Requirements Document

SSP 50094 NASA/RSA Joint Specification/Standards Document for the ISS Russian Segment

SSP 50108 Certification of Flight Readiness Process

SSP 50137 NASA/RSA Bilateral Data Exchange Agreement

2.0 SAFETY PROGRAM

2.1 SAFETY MANAGEMENT

2.1.1 ROLES AND RESPONSIBILITIES

2.1.1.1 NASA ROLES AND RESPONSIBILITIES:

NASA Safety has the following roles and responsibilities for the ISS:

a) To establish the overall safety requirements covering ISS detailed design, development activities, and mature operations and utilization.

b) To certify that the overall integrated Space Station elements and payloads are safe.

c) To conduct overall integrated system safety reviews for Space Station elements, launch packages and stages.

d) To conduct safety reviews for the elements and payloads provided by NASA.

e) To participate in and support as appropriate the reviews of other partners. To support these reviews, NASA will provide the necessary safety related information to enable the partners to conduct their reviews.

f) To conduct interface hazards analysis between elements of the RS and elements of other International Partners (IP)

2.1.1.2 RSA ROLES AND RESPONSIBILITIES

RSA has the following roles and responsibilities:

a) To develop detailed safety requirements which implement the overall safety requirements for the elements and payloads developed by RSA. These detailed requirements must meet or exceed the safety requirements in SSP 41163, including those specified in the SSP 50094, NASA/RSA Joint Specifications / Standards Document for the RS.

b) To certify that the overall and detailed safety requirements have been met with respect to the elements and payloads RSA provides.

c) To support the overall integrated system safety reviews conducted by NASA. This support includes participation as a developer and provider of safety data for elements being reviewed by the ISS Safety Review Panel (SRP). As a provider of data RSA participation in the meeting shall include the presentation of the safety data to the SRP and technical support to respond to

questions related to the identification and control of hazards related to the detailed design and operation of the RS elements.

d) To conduct safety reviews for the elements and payloads provided by RSA.

e) To participate in and support as appropriate the reviews of other partners. To support these reviews RSA will provide the necessary safety related information to enable other IPs to conduct their reviews.

f) To participate, as appropriate, in any Space Station safety review boards established by NASA. This includes membership in the ISS SRP which will conduct the overall integrated safety review of ISS elements. Elements being launched on the Space Shuttle shall be subject to the GSRP process documented in Attachment A. Payloads for the ISS shall be subject to the Payloads SRP process documented in Attachment D (TBD).

g) To provide the support and information necessary for integrated analyses and assessments which lead to NASA's safety certification responsibilities.

2.1.2 ORGANIZATION

Organization of the NASA and RSA safety effort shall assure effective planning, management, implementation and performance of safety activities. While the accomplishment of all safety tasks may not be the responsibility of the same organizational element, management of the safety effort shall assure that all tasks are effectively accomplished.

2.1.3 SAFETY PLAN

The RSA and NASA safety organizations shall prepare, implement, and maintain a Safety Plan as a part of the S&MA Plan (Reference paragraph 1.3.3) which describes the compliance with requirements set forth herein.

2.1.4 SAFETY REVIEW REQUIREMENTS

2.1.4.1 SPACE STATION REVIEW

2.1.4.1.A SSP 30599, Safety Review Process, defines the safety review process that is used by NASA to implement its responsibilities for ISS elements.

2.1.4.1.B RSA shall utilize standard Russian S&MA processes to implement it's internal responsibilities for the RS.

2.1.4.1.C To assure the joint review of RS Safety, RSA and NASA shall implement the safety review process defined in the "NASA/RSA Safety Review Process" provided in Attachment C.

2.1.4.1.D For RS Russian Transport Vehicles (e.g. Soyuz TM, Progress M, and LTV) NASA and RSA shall implement the Safety Review Process defined in the "NASA/RSA Safety Review Process" with the following reduced scope:

- Hazards to the ISS caused by any ISS vehicle that is temporarily in the proximity of or docked to the ISS must be identified and controlled. This excludes Hazards associated with autonomous flight of these vehicles (i.e. launch operations, orbit insertion, deorbit, and landing)

- Hazards resulting from the inability of the vehicles to perform critical ISS functions (Reference Attachment A)

2.1.4.2 SPACE STATION PAYLOADS

2.1.4.2.1 TECHNICAL SAFETY REQUIREMENTS FOR ISS PAYLOADS

For ISS payloads the safety requirements are defined in NSTS 1700.7B. For RS payloads on ISS, RSA shall meet the safety requirements of "NASA/RSA Safety Policy and Requirements for ISS Payloads" provided in Attachment D (TBD).

2.1.4.2.2 SAFETY REVIEW PROCESS FOR RSA ISS PAYLOADS

For ISS payloads the safety review process is defined in NSTS 13830B. For RS payloads on ISS, RSA shall meet "NASA/RSA Safety Policy and Requirements for ISS Payloads" provided in Attachment D (TBD).

2.1.5 MISHAP REPORTING AND INVESTIGATION

Mishaps occurring during manufacturing, testing, and operations shall be investigated and reported as specified in the internal native specifications and reported in accordance to DID R-10-S03 and U-10-S09~~3~~ for RS and USOS mishaps, respectively.

2.1.6 WAIVERS AND DEVIATIONS

The NASA and RSA will evaluate proposed hardware, software, and operational waivers and deviations for safety impact, and recommend disposition for management concurrence. Where the acceptance of a deviation or waiver impacts an existing hazard report, the hazard report will be updated to show the accepted risk status and resubmitted with the waiver or deviation.

2.2 SAFETY

2.2.1 OBJECTIVES

The NASA and RSA safety objectives are to identify and evaluate their respective ~~RS~~ design and operational activities to assure that measures are taken to minimize risks. Safety objectives include the following:

2.2.1.A Performing safety analyses to identify the hazards associated with hardware, software, and operations during all program phases

2.2.1.B Assuring that proper design and performance requirements are developed, documented, and implemented which will eliminate whenever possible or control the identified hazards.

2.2.1.C Providing appropriate documentation to enable NASA and RSA to perform an overall risk assessment including: the identification of residual hazards/risks and providing recommendations with supporting data and rationale for management awareness and decision on acceptance of the residual hazards/risks.

2.2.2 SAFETY TECHNICAL REQUIREMENTS

Safety technical requirements have been established for the RS and the USOS and are defined in SSP 41163, "ISS RS Specification" and SSP 41162 "ISS USOS Specification", respectively. These requirements should be identified and implemented in system design, operations, and procurement documentation including flight hardware and safety critical software.

2.2.3 SAFETY ANALYSES

NASA and RSA shall perform hazards analyses, including hardware hazards analyses, operational hazards analyses, and software hazards analyses.

2.2.3.A NASA shall document the results of the USOS hazard analyses on hazard report forms as defined in SSP 30599. This documentation will be provided to RSA in accordance with the established distribution to the ISS Safety Review Panel.

2.2.3.B RSA shall document the results of RS hazard analyses, as defined in the "NASA/RSA Safety Review Process" provided in Attachment C, on hazard report forms in accordance with DID R-10-S02.

2.2.3.1 NASA GOVERNMENT EQUIPMENT FOR RS INSTALLATION

NASA equipment installed in the Russian Segment shall be subject to the process for safety reviews described in “NASA/RSA Safety Review Process.” RSA representatives shall take part in the work of the Safety Review Panel for this hardware.

2.2.3.2 INTEGRATED SAFETY DATA

To provide information required for the RS and ISS integrated hazard analysis, NASA and RSA will exchange Safety Data in addition to hazard analysis. NASA shall provide this data to RSA in accordance with DID U-10-S05 and U-10-S07. RSA shall provide this data in accordance with DID R-10-S04 and R-10-S06.

2.2.4 HAZARD ELIMINATION AND CONTROL

The foremost consideration for resolving hazards shall be to eliminate them by design through removal of hazard sources and hazardous operations. Corrective action priorities shall be established to achieve maximum benefit in reducing potential personnel and material losses. Actions for satisfying safety engineering requirements shall be in the following order of precedence:

2.2.4.A Hazard Elimination. The hazard source or the hazardous operation shall be eliminated.

2.2.4.B Design for Minimum Hazard. The major goal throughout the design phase shall be to ensure inherent safety through provisions of appropriate design features, materials and parts selection, and safety factors. Control and isolation of potential hazards and failure tolerance considerations are to be included in design considerations.

2.2.4.C Safety Devices. Known hazards which cannot be eliminated by design shall be reduced to an acceptable level by incorporating safety devices as part of the system, subsystem, or equipment.

2.2.4.D Warning Devices. Where it is not possible to preclude the existence or occurrence of a known hazard, warning devices shall be employed for the timely detection of hazardous conditions and the generation of adequate warning signals.

2.2.4.E Special Procedures. Where it is not possible to reduce the magnitude of an existing or potential hazard by design or by use of safety and warning devices, special procedures (including the requirement for Personal Protective Clothing/Equipment) shall be developed to counter hazardous conditions for enhancement of ground and flight crew safety.

2.2.5 HAZARD REPORT/OFF-NOMINAL-SITUATION (ONS) CLOSURE CRITERIA

A hazard report/ONS shall be considered closed only after at least one of the following conditions have been satisfied:

(1) The hazard/ONS has been eliminated by a design or operational change, and the change has been implemented and verified or;

(2) The hazard/ONS has been controlled in accordance with at least one of the corrective actions identified in paragraph 2.2.4.B through 2.2.4.E, and the controls have been verified by successful completion of the required design change, test programs, analytical studies, or training programs or;

(3) The hazard has been accepted by program management. Signature of the phase 3 safety hazard report at the conclusion of the NASA/RSA Safety Review Panel meetings shall indicate ISS program approval of the identified hazard.

2.2.6 GROUND SUPPORT EQUIPMENT (GSE) SAFETY

2.2.6.A RS GSE safety requirements have been established for the RS and are defined in SSP 41163.

2.2.6.B USOS GSE safety requirements have been established for the USOS and are defined in SSP 41162.

2.2.7 REVIEW OF CHANGES

When changes are proposed for equipment design (hardware and software) or procedures, NASA and RSA safety organization shall assure the identification and resolution of hazards that may be introduced into the system. These hazards shall be documented in hazard reports in accordance with the DID R-10-S02 for the RS, and in accordance with SSP 30309 and SSP 30599 for the USOS, respectively.

2.2.8 REVIEW OF FLIGHT AND GROUND HARDWARE FAILURES

NASA and RSA safety organization shall review, provide recommendations and concur in failure resolutions associated with catastrophic and critical hazards.

2.2.9 EVALUATION OF TEST RESULTS

NASA and RSA safety organizations shall evaluate results of tests that verify design safety compliance.

2.2.10 EVALUATION OF MISSION OPERATIONAL ACTIVITY

NASA and RSA safety organizations shall participate in mission operational activities and make safety evaluations of anomalous conditions. These safety evaluations will provide guidance to plan future activities and to establish necessary corrective actions.

2.3 INDUSTRIAL SAFETY

2.3.A Russian Industrial and personnel safety standards apply for all ISS hardware while in Russian facilities.

2.3.B US industrial and personnel safety standards apply for all ISS hardware while in US. facilities.

2.3.1 GROUND OPERATIONS SAFETY

2.3.1.A Russian ground operations safety standards apply for all ISS hardware while in Russian facilities.

2.3.1.B US ground operations safety standards apply for all ISS hardware while in U.S. facilities.

3.0 RELIABILITY AND MAINTAINABILITY (R&M)

3.1 MANAGEMENT

3.1.1 NASA ROLES AND RESPONSIBILITIES

a) NASA is responsible for establishing overall R&M technical and process requirements which will be necessary to assure vehicle life and system availability for scientific utilization. In doing this, NASA defines the system level R&M design requirements and is responsible for allocating and coordinating the appropriate requirements with RSA for the RS.

b) NASA defines and documents the analytical processes which are to be used to perform integrated R&M assessments for the ISS. NASA is responsible to identify and agree with RSA on the processes applicable to the RS and the data required to fulfill NASA's integration needs.

c) NASA will be responsible to assure that R&M requirements allocated to the RS have been verified by the RS providers or that the requirements are specifically verified by NASA. NASA is also responsible to assist RS providers in identifying verification methods for each R&M requirement.

d) NASA is responsible to provide the program manager and program teams with status of R&M requirements implementation and an assessment of the risk involved for further evaluation at the program level.

3.1.2 RSA ROLES AND RESPONSIBILITIES

a) RSA is responsible for developing the R&M requirements allocated to the RS in SSP 41163, "ISS RS Specification" for the elements and payloads provided by RSA. These detailed requirements must meet or exceed the requirements of SSP 41163.

b) For each R&M requirement allocated to the RS, RSA is responsible for defining and conducting verification activities necessary to assure that the requirement is met.

c) RSA is responsible to provide status of implementation and verification results for R&M requirements to NASA.

d) RSA is responsible to provide NASA with R&M data , in order to support NASA's responsibilities to perform integrated analyses of the ISS.

e) RSA will be responsible for the certification of the R&M characteristics of the RS with respect to the overall program R&M requirements.

3.1.3 RECIPROCITY

NASA and RSA shall establish and maintain a Reliability and Maintainability function which possesses attributes, performs the functions, or supplies the data described herein.

3.1.4 ORGANIZATION

Organization of the NASA and RSA reliability and maintainability efforts shall assure effective planning, management, implementation, and performance of reliability and maintainability activities. While the accomplishment of all reliability or maintainability tasks may not be the responsibility of the same organizational element, management of the reliability and maintainability efforts shall assure that all tasks are effectively accomplished.

3.1.5 PLANS

3.1.5.1 RELIABILITY AND MAINTAINABILITY PLANS

The NASA and RSA reliability organizations shall prepare, implement and maintain an integrated reliability and maintainability (R&M) plan, or separate plans, as a part of the S&MA Plan, which describes how the reliability and maintainability requirements will be implemented, controlled and verified and shall be prepared and maintained in accordance with DID R-10-S01 and U-10-S08~~1~~ for RSA and NASA, respectively.

3.1.6 SUPPLIER CONTROL

3.1.6.1 SUPPLIER RELIABILITY AND MAINTAINABILITY CONTROL

The RSA and NASA reliability and maintainability efforts shall assure that ISS (USOS and RS) hardware obtained from any source meets the reliability and maintainability requirements of the overall system.

3.2 RELIABILITY AND MAINTAINABILITY ENGINEERING

3.2.1 RELIABILITY AND MAINTAINABILITY DESIGN CRITERIA

The reliability and maintainability efforts shall include a systematic approach for reviewing and concurring in design and procurement specifications and in design changes to assure that all design items reflect proper and complete reliability and maintainability design criteria and that the specifications contain applicable reliability and maintainability requirements.

Reliability and maintainability engineering tasks shall be accomplished, to the extent specified, for all flight equipment. Maintainability engineering efforts shall support maintenance planning efforts as appropriate.

3.2.2. FAILURE MODE EFFECTS ANALYSIS/CRITICAL ITEMS LIST (FMEA/CIL)

3.2.2.1 USOS FAILURE ANALYSIS PROCEDURE

The USOS segment shall perform Failure Mode Effects Analysis/Critical Items List (FMEA/CIL) in accordance with SSP 30234 Revision D.

3.2.2.2 RSA FAILURE ANALYSIS PROCEDURE

The RS segment shall perform failure analysis in accordance with it's own standards and methodology in order to identify critical items and evaluate failure effects on critical capabilities and interfaces with other segments of ISS.

3.2.2.3 FAILURE MODE SUMMARY REPORT (FMSR)

Each respective segment shall exchange the results of failure analysis required by paragraphs 3.2.2.1 and 3.2.2.2 in the FMSR. At a minimum the FMSR shall be prepared for equipment whose single failure manifests critical effects at the physical and functional interfaces to the associated segment. The analysis shall be used to summarize the cases of non-compliance with segment specification reliability requirements and to identify critical items. These analyses shall be documented in accordance with DID R-10-R01 and U-10-R05~~1~~ for RSA and NASA, respectively.

3.2.2.4 PAYLOAD FMEAs

RESERVED

3.2.3 CRITICALITY CATEGORIES

Criticality Categories are defined in DID R-10-R03, and SSP 30234**.**

3.2.4 CRITICAL ITEMS LIST (CIL)

The CIL determines the equipment for which the established requirements for reliability and safety are not fully met. Preparation of the CIL will utilize a structured process which will assure that all failure modes of each component of critical functions of the ISS are considered in the critical items analysis. Based on results of system analysis, the CIL includes justification for use of the Critical Element as part of the ISS. CIL preparation, maintenance, and control are aimed at assuring an efficient monitoring of critical elements of the ISS, and initiation of corrective action to reduce the criticality of these elements. The CIL shall be prepared for the RS in accordance with DID R-10-R03. USOS CIL will be provided to RSA in accordance with DID U-10-R05~~1~~.

3.2.5 R&M PREDICTIONS REPORT

3.2.5.A R&M Predictions data will be used to document the results of the ISS R&M analyses. NASA and RSA shall exchange R&M Prediction data. The reliability data shall be collected for functions critical to ISS as a whole. The R&M Predictions Report will be used to status analysis results concerning segment reliability, segment maintainability allocations, provide data which will be used to develop an integrated preventive maintenance plan, and to provide data which can be used to perform integrated system level predictions of R&M characteristics. For RS, this report shall be developed in accordance with DID R-10-R02. For the USOS, this data will be reported in accordance with DID U-10-R06~~2~~.

3.2.5.B

RESERVED

3.2.5.1 RELIABILITY

3.2.5.1.A LIMITED-LIFE DATA

RESERVED

3.2.5.1.B RELIABILITY PREDICTION DATA

Reliability prediction data for hardware shall be compiled to assess the reliability of the ISS**.**

3.2.5.2 MAINTAINABILITY

Maintainability data for RS and USOS flight elements shall be compiled in order to estimate the time and equipment required to maintain RS and USOS systems, both during assembly and at assembly complete.

3.2.6 DESIGN REVIEWS

RSA and NASA Reliability and maintainability activities shall include supporting RS and USOS internal design reviews and Space Station Program design and readiness reviews. Participation in reviews shall assure that reliability and maintainability requirements are adequately considered in such reviews.

3.2.7 REVIEW OF CHANGES

When changes are proposed for equipment design (hardware and software) or procedures, the changes shall include a review of the reliability and maintainability impact of the proposed changes.

3.2.8 FAILURE REPORTING SYSTEM

Reliability and maintainability activities shall support the failure reporting system (defined in paragraph 4.4).

3.2.9 VERIFICATION ASSURANCE

RSA and NASA Reliability and maintainability shall assure that an effective verification program is established and implemented for RS and USOS hardware and software. Reliability and maintainability activities shall include participation in such verification processes as development, certification, acceptance, checkout and maintainability verification.

4.0 QUALITY ASSURANCE

4.1 MANAGEMENT

4.1.1 NASA ROLES AND RESPONSIBILITIES

a) NASA is responsible for establishing overall QA program requirements for ISS and to allocate and coordinate them with RSA for the RS.

b) NASA is responsible to establish and coordinate with RSA the QA data on RS equipment necessary to support integrated assessments of equipment certification status and problem resolution of critical ISS capabilities and segment interfaces.

c) NASA is responsible to provide RSA with problem resolution status for USOS/RS interfaces, and critical functions for the ISS in accordance with DID U-10-QA03~~1~~.

4.1.2 RSA ROLES AND RESPONSIBILITIES

a) RSA is responsible to conduct QA activities for the RS .in accordance with the requirements agreed upon with NASA.

b) RSA is responsible to notify NASA of unresolved problems identified while conducting QA activities which may impact RS quality, on-orbit performance, and safety.

c) RSA is responsible to provide NASA with problem resolution status for equipment which supports critical functions and at RS/USOS interfaces in accordance with DID R-10-QA01.

4.1.3 RECIPROCITY

NASA and RSA shall establish and maintain a Quality Assurance function which possesses attributes, performs the functions, or supplies the data described herein.

4.2 QUALITY PROGRAM PLAN

RSA and NASA shall prepare, implement and maintain a Quality Program Plan, as a part of the S&MA Plan, which describes the compliance with requirements established by RSA and NASA. The QA plan shall describe how the quality requirements will be implemented, controlled and verified and shall be prepared and maintained in accordance with DID R-10-S01 and DID U-10-S08~~1~~.

4.3 ACCEPTANCE DATA PACKAGE (ADP).

NASA and RSA shall compile Acceptance Data for all flight equipment in accordance with native requirements. This data shall be retained for the operational life of the equipment.

4.4 FAILURE REPORTING AND CORRECTIVE ACTION

A closed-loop system shall be provided for reporting and correcting failures. All problems involving flight articles shall be included in this system. NASA and RSA shall conduct activities aimed at failure detection, analysis of causes, and development of corrective actions, including supporting information in accordance with the respective existing requirements. NASA and RSA shall exchange information about in-flight failures of interface equipment and equipment performing critical ISS functions. Detailed requirements for failure reporting, analysis, and resolution shall be in accordance with DID R-10-QA01 and U-10-QA03~~1~~, Failure Reporting and Corrective Action (FRACA) System Requirements.

4.5 CONTROL OF NASA AND INTERNATIONAL PARTNER (IP) PROPERTY

When NASA or IP property is under the control of RSA, the following requirements apply. (Note: these requirements will apply to NASA, when RSA property is under the control of NASA)

4.5.1 RSA RESPONSIBILITY

RSA Quality Assurance shall ensure that a documented system for controlling NASA and IP property and associated documentation has been established and is maintained as follows:

4.5.1.1 Upon receipt, contractor Quality Assurance shall inspect NASA and IP property to detect damage in transit and to verify that the article and its ADP are complete and as specified in the shipping documents. Articles found to be serviceable shall be re preserved and repackaged unless the articles are to be used immediately. Should there be evidence of damage in transit, the article shall be inspected to determine the extent of damage and a report of the damage provided to the designated NASA or IP representative. Receiving inspection results shall be recorded in the historical record for the article.

4.5.1.2 When functional testing is performed on NASA and IP property during receiving inspection or prior to installation into the next level of assembly, the designated NASA or IP representative shall be notified and may participate in the testing activity.

4.5.1.3 Documented procedures shall describe the control of approved storage areas for NASA or IP property. Controls shall include the following:

--Limited personnel access
--Controlled receipt and withdrawal
--Identification of article status
--Inventory list of articles in the area
--Scheduled inspection of the area and periodic verification of the inventory list
--Controls for items that must be environmentally protected

4.5.1.4 RSA shall provide for the protection, maintenance, calibration, periodic inspection, segregation, and controls necessary to ensure that quality of NASA and IP property is maintained

and that damage and deterioration do not occur during handling, storage, installation, or shipment.

4.5.1.5 NASA and IP property shall not be diverted or loaned from its assigned purpose without the prior approval of the designated NASA or IP representative.

4.5.2 UNSUITABLE NASA OR IP PROPERTY

NASA and IP property found to be damaged or otherwise unsuitable for its intended use shall be identified as nonconforming, segregated to the extent practicable, held for review, and analyzed to ascertain the probable cause of damage. When the cause is determined to be in the RSA's operations or activities, action shall be taken to prevent recurrence. Disposition shall not be assigned to discrepant NASA and IP property nor shall this property be reworked, repaired, modified, or replaced without the specific written authorization of NASA or the IP. NOTE: Paragraph 4.4 may apply.

5.0 SOFTWARE QUALITY ASSURANCE

SPA is a technical discipline which establishes requirements and criteria for the evaluation, assessment, assurance and enhancement of software safety, reliability, maintainability, and quality. It is to be accomplished to the extent specified for International Space Station software, including flight software, flight support software, software used for their design, development, verification, storage and maintenance, and software that controls or could effect flight hardware or software. SPA requirements apply to the software portions of a system. Assurance of a system shall include software affecting the system safety, reliability, maintainability or quality, and shall emphasize the use of preventative, as well as, corrective methods.

ISS Product Assurance requirements for hardware and operational procedures are addressed only as they relate to software. SSP 41000, System Specification for the International Space Station, and other paragraphs of this document "NASA/RSA Bilateral Safety and Mission Assurance Process Requirements," provide requirements for aspects of safety, reliability, maintainability and Quality Assurance that relate to the other system components, and are not repeated here.

This chapter establishes common SPA requirements for the ISS organizations including the International Partners, and contractors. The SPA requirements for the International Partners shall be equivalent to the requirements of this paragraph. Software which is loaded in a class of memory that cannot be dynamically modified (i.e., firmware) is subject to these software assurance requirements to the extent practical.

5.1 MANAGEMENT

Software product assurance activities shall be planned, managed, and integrated in conjunction with other management, and technical functions to assure a complete, concise, and consistent approach to the development of program plans, and compliance with ISS program requirements.

5.1.1 ORGANIZATION

SPA shall be accomplished in accordance with the overall QA systems, accepted by NASA and RSA respectively. Personnel responsible for ensuring compliance with SPA requirements shall have the resources, responsibility, authority and organizational freedom to permit objective evaluations. SPA shall have the authority to initiate the corrective action process, and to verify corrective actions.

SPA management shall be structured to provide planning, management, and implementation of all SPA activities. While the accomplishment of all SPA tasks may not be the responsibility of a single organizational element, management of the SPA activities shall be coordinated with project management to ensure that all SPA requirements are assigned to the appropriate organization. Managers of all SPA functions shall have direct access to, and shall report status and issues to project management. Personnel evaluating a product or activity shall be personnel other than

those who develop the product, perform the activity, or who are responsible for the product or activity. This does not preclude members of the development team from providing support to these evaluations.

5.1.2 SOFTWARE PRODUCT ASSURANCE PLANNING

SPA activities shall be planned and implemented throughout the software life-cycle. The procuring agency and the developer shall prepare and maintain SPA plans, which shall describe assurance activities during each life-cycle phase. SPA plans shall include an explanation of how tools, rules and procedures will be used to accomplish SPA activities. The preparation of SPA plans and other development plans shall be coordinated to assure an integrated approach. The ISS Quality Assurance IPT TEP, which includes Software Quality Assurance (SQA), and the RSA SPA Program Plan will be exchanged in accordance with SSP TBD, NASA/RSA Data Exchange Agreements, Lists and Schedules.

5.1.3 FORMAL AND INTERNAL REVIEWS

SPA shall participate in formal program, project, and software reviews to evaluate and report on compliance with ISS requirements. SPA shall have the option to participate in all reviews. Through participation in reviews, SPA shall assure that higher level requirements have been considered in decisions which affect detailed software requirements, software design, configuration controls, Computer Software Configuration Item (CSCI) testing, integration testing, acceptance, and readiness for flight. SPA shall evaluate software data presented to support management in assessing whether or not to proceed with the next program phase.

5.1.4 SUBTIER REQUIREMENTS

SPA shall assure that the requirements in this document are flowed down and adhered to by contractors, subcontractors, and other subtier providers of software. Direction and control shall be provided to assure that SPA requirements are properly implemented.

5.1.5 NONDEVELOPMENTAL SOFTWARE

SPA shall evaluate each item of nondevelopmental software to be incorporated into deliverable software to assure that:

5.1.5.1 Objective evidence exists, prior to its incorporation, that it performs its required functions

5.1.5.2 It is placed under contractor internal configuration management control prior to its incorporation into the developmental configuration

5.1.5.3 The data rights provisions are consistent with contractual and program requirements.

5.1.6 NASA OR INTERNATIONAL PARTNER FURNISHED EQUIPMENT (GFE/IGFE)

When software, related hardware, and documentation are furnished as GFE/IGFE, the accompanying ADP shall be reviewed. If it is determined that the GFE/IGFE does not provide functionality or performance consistent with its documented requirements or the GFE/IGFE is not consistent with the ADP, SPA shall ensure that the providing NASA Center or International Partner is promptly and formally notified.

5.1.7 PROGRESS REPORTING

SPA activities shall be reported through management meetings and status reports.

5.1.8 CONTROL BOARDS

SPA shall participate as members on configuration control boards, and other boards to assure changes are processed in accordance with approved plans and procedures, and to assure that safety, reliability, maintainability, and quality requirements are met.

5.1.9 OPERATIONS AND MAINTENANCE

SPA shall assure that a process is established for the planning and evaluation of software operation and sustaining engineering activities. The process shall ensure the retention of safety, reliability, maintainability, and quality attributes, and that changes will not adversely affect the required system failure tolerance.

5.1.10 TRAINING

SPA personnel shall have the training and qualifications commensurate with job responsibilities.

5.1.11 SOFTWARE TOOLS

SPA shall ensure software tools used in the development, verification and validation, integration, and test of deliverable software products (such as compilers and code checkers) are placed under configuration control prior to use, are maintained to an approved configuration, and operate consistent with approved configuration, and operate with approved changes following any modification or update.

5.1.12 SOFTWARE PRODUCT ASSURANCE RECORDS

SPA shall implement a system to identify, control and status SPA records generated as a result of the performance of SPA activities throughout the software life-cycle. SPA records shall be retained in a safe, accessible location for a period specified by the procuring agency.

5.2 SOFTWARE QUALITY ASSURANCE

Software development or acquisition shall be evaluated by SPA. SPA shall assure that: standards and procedural controls are established and implemented; audits, evaluations, and reviews are accomplished; procedures are followed; and all assurance activities are performed as scheduled.

5.2.1 AUDITS

SPA shall establish a plan and process to audit all activities conducted as part of the software life-cycle. Audits on activities such as development, documentation, testing, configuration management, nonconformance reporting, and corrective action activities shall be conducted on a scheduled and unscheduled basis. SPA shall verify compliance with approved standards and procedures for these activities.

5.2.2 TOOLS, TECHNIQUES, AND METHODOLOGIES

SPA shall assure that software tools used in the development, verification and validation, integration and test of deliverable software products are evaluated, and that objective evidence exists that the tools perform their required functions. SPA shall participate in the identification and assessment of software development techniques and methodologies that facilitate the development of safe, reliable, maintainable, and quality software products.

5.2.3 SOFTWARE DOCUMENTATION

SPA shall ensure software documentation reviews are conducted throughout the software and acquisition life cycle. SPA shall review software documentation to ensure compliance with ISS documentation standards and applicable contractual requirements. SPA shall review software acquisition documentation to ensure software product assurance requirements are included. SPA shall ensure software development documentation is reviewed for conformance to applicable data requirements.

Software development documentation reviews shall be conducted to ensure the following:

5.2.3.1 Software requirements specifications contain software requirements that are complete, concise, consistent, accurate, realistic, unambiguous, verifiable, and traceable to higher level requirements.

5.2.3.2 Software design specifications have incorporated all applicable software requirements and that the software design conforms to applicable software standards and conventions.

5.2.3.3 Interface documents accurately specify hardware-to-software, software-to-software, and user-to-software interfaces.

5.2.3.4 Software test plans describe an acceptable test philosophy and approach, software test procedures verify applicable software requirements, and software test reports accurately reflect the conduct of each test.

SPA shall evaluate software documentation delivery processes and procedures to ensure delivery of complete, correct, and compliant software documentation and change information.

5.2.4 SOFTWARE CODE INSPECTION

SPA shall selectively participate in software code inspections and walkthroughs to ensure compliance with coding standards and design requirements. SPA shall verify the completion of all software code inspections and walkthroughs prior to integration and formal testing.

5.2.5 SOFTWARE TESTING

For all deliverable software preparatory to and during formal testing, SPA shall:

5.2.5.1 Review and approve test plans and procedures to verify conformance of test to requirements.

5.2.5.2 Verify documentation of the current configuration of the total test environment prior to any formal software test activities, to assure repeatability of test results, and to aid in the resolution and disposition of nonconformances.

5.2.5.3 Verify the software and test documentation configuration to assure approved and correct versions are used for testing, and to assure that only approved changes have been incorporated.

5.2.5.4 Selectively participate in tests and review test results to assure that test procedures have been performed, all test requirements have been met, and that actual test results are recorded.

5.2.5.5 Assure nonconformances are reported in accordance with paragraph 5.4.

5.2.5.6 Review test reports for completeness and accuracy.

5.3 CONFIGURATION MANAGEMENT

5.3.1 CONFIGURATION IDENTIFICATION, STATUS ACCOUNTING AND VERIFICATION

Software baselines established at the end of life-cycle phases, including configurations delivered for formal testing or for operational use, shall be evaluated or audited, as appropriate, to verify that the baselined configurations are correct, and at the proper revision level.

5.3.2 CONFIGURATION CHANGE CONTROL

The processing and implementation of change requests shall be evaluated to assure that the product conforms to baselined requirements and standards, only approved changes were implemented, and that the change has been incorporated in accordance with approved procedures. Change requests shall be reviewed for impact on software safety, reliability, maintainability, and quality.

5.3.3 SOFTWARE LIBRARIES

Software libraries shall be audited, and their processes evaluated to assure adherence to baselined configuration management processes, and to assure the proper storage and handling of software media and documentation. The audits and evaluations shall assure that different computer program versions are accurately identified and documented, only authorized modifications are made, modifications are made in accordance with approved procedures, and software submitted for testing or operation is the required version.

5.3.4 DEVIATIONS AND WAIVERS

SPA shall evaluate all deviation and waiver requests to ISS baselined software requirements for potential impacts affecting safety, reliability, maintainability and quality, and recommend dispositions for management concurrence.

5.4 NONCONFORMANCE REPORTING AND CORRECTIVE ACTION

SPA shall ensure the establishment, implementation, and maintenance of a documented closed-loop system for nonconformance/problem reporting, and corrective action.

5.4.1 NONCONFORMANCE REPORTING

SPA shall assure a documented nonconformance reporting system exists throughout the software life-cycle. SPA shall ensure that the nonconformance reporting system includes provisions for recording, analysis, recurrence control, verification, and generation of summary and detailed reports on software which does not conform to specifications/requirements. Nonconformance reports shall be analyzed, including trend analyses, to categorize software errors, and to identify potential weaknesses in software life-cycle processes and products. Results of the analyses, and the actions taken shall be documented.

5.4.2 PROBLEM REPORTING AND CORRECTIVE ACTION

Detailed requirements for problem reporting, analysis, and resolution shall be in accordance with this agreement. SPA shall ensure that procedures are in place to evaluate the impact of a reported problem, the resources required for corrective action, and the impact of not taking corrective action. The procedures shall include requirements for retesting the software, and a process for incorporating the correction in new versions of the software. Software problem reporting and corrective action will be exchanged as part of the Failure Report in accordance with DID R10-QA01 and U10-QA03~~1~~, NASA/RSA Data Exchange Agreements, Lists and Schedules.

5.5 RESERVED

5.6 SOFTWARE SAFETY

SPA shall assure analyses, of software, are performed as part of system safety analyses in accordance with the NASA/RSA Safety Review Process.

5.7 STANDARDS

SPA shall assure that software development standards are established and implemented. SPA shall assure that the software development standards meet ISS requirements, and support ISS objectives. SPA shall assure that the software development standards facilitate the development of safe, reliable, maintainable, and quality software products.

5.8 TRADE STUDIES

SPA shall assess the plan for trade studies, and their results to ensure that appropriate reliability and maintainability requirements are included.

5.9 INTEGRATION ASSURANCE

SPA shall ensure that a process exists to evaluate and integrate the software-to-hardware interfaces, software-to-software interfaces, and software-to-user interfaces of the system to meet the requirements defined in the interface documentation, and those contained in SSP 30459, Space Station Interface Development Process Requirements.

5.10 VERIFICATION AND VALIDATION

SPA shall ensure that verification and validation activities are performed for ISS software in accordance with SSP TBD, NASA/RSA Bilateral Integration and Verification Plan. SPA shall ensure that traceability analyses are performed from system level requirements to detailed requirements, to design, to code, to test, and back, to assure traceability of all requirements and the exclusion of unauthorized functions.

5.11 INDEPENDENT VERIFICATION AND VALIDATION (IV&V)

SPA shall ensure that IV&V is performed in accordance with applicable requirements (or for International Partners, equivalent activities which fulfill the intent of IV&V).

5.12 CERTIFICATION

SPA shall ensure that products requiring certification meet the following prerequisites:

5.12.1 Verification that the software products were developed and supported according to an approved process.

5.12.2 Verification that all software products are present, complete, current and controlled, and that no open noncomformances exist which are safety or mission critical.

5.12.3 Validation that the software products meet all of the applicable requirements including safety and reliability requirements.

5.12.4 Validation that the software products meet the requirements contained in SSP TBD BIVP.

5.12.5 Validation that the software products meet the requirements contained in SSP 50108 Certificate of Flight Readiness Process Document..

5.13 SECURITY AND PRIVACY ASSURANCE

SPA shall ensure that system security and privacy requirements for ISS have been implemented in accordance with approved procedures.

GLOSSARY

Catastrophic Hazard - Any condition which may cause a disabling or fatal personnel injury, or cause loss of one of the following: the Orbiter, ISS, or major ground facility. Loss of ISS is to be limited to those conditions resulting from failures or damage to elements in the critical path of the ISS that render the ISS unusable for further operations, even with contingency repair or replacement of hardware, or which render the ISS in a condition which prevents further rendezvous and docking operations with ISS launch elements.

Critical Hazard - Any condition which may cause a non-disabling personnel injury severe occupational illness; loss of a ISS element, on-orbit life sustaining function or emergency system; or involves damage to the orbiter or a major ground facility. For safety failure tolerance considerations, critical hazards include loss of ISS elements that are not in the critical path for station survival or damage to an element in the critical path which can be restored through contingency repair.

Residual Risk - Risk that remains from a hazard after all mitigation and controls have been applied.

Critical Function - Any capability required to achieve the Mission Objectives of the ISS, such as providing a micro-g working environment for the conduct of scientific inquiry.

Mishap -Any unplanned occurrence, event, or anomaly. Mishaps that should be reported include those mishaps that may have significant program impact, may affect schedule, or cause death or permanent injury of crew or ground personnel.

Payload - For ISS: Any hardware and its contents, which is used on-board the ISS for carrying out research and technical experiments or production of materials; transported up to, located on-board (internal or external), or transported down from ISS but not part of the operational subsystems, and structure of the ISS.
For Space Shuttle: Any hardware and its contents, transported (up to orbit and/or down from orbit) by the Space Shuttle (located in either the mid-deck or payload bay areas) but not part of a Space Shuttle system.

ADP Acceptance Data Package
CIL Critical Items List
DID Data Item Description
FMEA Failure Modes and Effects Analysis
FRR Flight Readiness Review
GFE Government-Furnished Equipment
GSE Ground Support Equipment
IP International Partner
NASA National Aeronautics and Space Administration
NDE Nondestructive Evaluation

NHB NASA Handbook
NSTS National Space Transportation System
ORU Orbital Replaceable Unit
PRACA Problem Reporting and Corrective Action
RS Russian Segment
RSA Russian Space Agency
SRP Safety Review Panel
SSCB Space Station Control Board
STD Standard
STS Space Transportation System
TBD To Be Determined
USOS United States On-orbit Segment

ATTACHMENT A - GROUND SAFETY REQUIREMENTS FOR RUSSIAN ELEMENTS (SCIENCE POWER PLATFORM) LAUNCHED ON THE NASA SHUTTLE

TBD

ATTACHMENT B - DATA ITEM DESCRIPTION (DIDs)

DATA ITEM DESCRIPTION (DID)

1. DID Number: R-10-S01

2. DID Title: Safety and Mission Assurance (S&MA) Plan

3. Approval Required Yes__X__ No _____

4. Initial Submittal Date: May 15, 1996

5. Update Frequency: N/A

6. Number of Copies:
   6.1 English version: N/A
   6.2 Russian version: 1

7. Preparation information:

7.1 Use: To define RSA planned method of accomplishing S&MA task required to show compliance with requirements in SSP 41163 and NASA/RSA Bilateral S&MA Process Requirements for ISS for all RSA provided international partner contributions to the ISS.

7.2 Content: The S&MA Plan shall address the philosophy, organization , approach and processes for all aspects of Safety, Reliability, Maintainability, Quality Assurance, and Software Quality Assurance programs. The plan should include all stages to the program including design, manufacture and test, certification and verification, flight test, operations, and document control.

7.2a. Safety Plan: The Safety Plan shall define the methodology and techniques for achieving safety requirements. This will be a description of how the safety program will be conducted to meet the design requirements and process requirements. The plan shall include, as a minimum, the following:

1. An identification of each task, as defined in other DIDs to be accomplished under the safety program.
2. A description of how each task will be performed
3. The procedures (where existing procedures are applicable) to evaluate the status and control of each task
4. The identification of the organization unit with the authority and responsibility for executing each task

7.2b. Reliability Plan: The Reliability Plan shall define the methodology and techniques for achieving Reliability requirements. This will be a description of how the Reliability program will be conducted to meet the design requirements and process requirements. The plan shall include, as a minimum, the following:

1. An identification of each task, as defined in other DIDs to be accomplished under the Reliability program.
2. A description of how each task will be performed
3. The procedures (where existing procedures are applicable) to evaluate the status and control of each task
4. The identification of the organization unit with the authority and responsibility for executing each task

7.2c. Maintainability Plan: The Maintainability Plan shall define the methodology and techniques for achieving Maintainability requirements. This will be a description of how the Maintainability program will be conducted to meet the design requirements and process requirements. The plan shall include, as a minimum, the following:

1. An identification of each task, as defined in other DIDs to be accomplished under the Maintainability program.
2. A description of how each task will be performed
3. The procedures (where existing procedures are applicable) to evaluate the status and control of each task
4. The identification of the organization unit with the authority and responsibility for executing each task

7.2d. Quality Assurance Plan: The Quality Assurance Plan shall define the methodology and techniques for achieving Quality Assurance requirements. This will be a description of how the Quality Assurance program will be conducted to meet the design requirements and process requirements. The plan shall include, as a minimum, the following:

1. ORGANIZATION
2. PLANNING FOR ON-ORBIT ACTIVITIES
3. TRAINING
4. INTERNAL QUALITY PROGRAM AUDITS AND SURVEYS
5. MILESTONE REVIEWS
6. DESIGN AND DEVELOPMENT CONTROLS
7. CHANGE CONTROL VERIFICATION
8. PRODUCT/PROCESS DEVELOPMENT AND VALIDATION
9. IDENTIFICATION AND DATA RETRIEVAL
10. RETENTION OF RECORDS
11. SUPPLIER/PROCUREMENT CONTROLS
12. RECEIVING INSPECTION
13. AUDITS AND SURVEYS OF PROCUREMENT SOURCE OPERATIONS
14. FABRICATION CONTROLS

15. ARTICLE AND MATERIAL CONTROLS
16. CLEANLINESS/CONTAMINATION CONTROL
17. PROCESS CONTROLS
18. NONDESTRUCTIVE EVALUATION (NDE)
19. WORKMANSHIP STANDARDS
20. CONTROL OF TEMPORARY INSTALLATIONS AND REMOVALS
21. TEST CONTROLS
22. INSPECTION AND TEST RECORDS AND DATA
23. NONCONFORMANCE CONTROL SYSTEM
24. PROBLEM REPORTING
25. METROLOGY
26. HANDLING, STORAGE, PRESERVATION, MARKING, LABELING, PACKAGING, PACKING, AND SHIPPING
27. SAMPLING PLANS, STATISTICAL PLANNING, AND ANALYSES

7.2e. Software Quality Assurance The Software Quality Assurance Plan shall define the methodology and techniques for achieving Software Quality Assurance requirements. This will be a description of how the Software Quality Assurance program will be conducted to meet the design requirements and process requirements. The plan shall include, as a minimum, the following:

1. An identification of each task, as defined in other DIDs to be accomplished under the Software Quality Assurance program.
2. A description of how each task will be performed
3. The procedures (where existing procedures are applicable) to evaluate the status and control of each task
4. The identification of the organization unit with the authority and responsibility for executing each task

7.3 Format: The S&MA Plan will be organized by the major functions of S&MA. Organization with a separate volume for each discipline area will permit each volume to be revised and approved (i.e., Safety, Reliability, Maintainability, Quality Assurance, and Software Quality Assurance.

DATA ITEM DESCRIPTION (DID)

1. DID Number: U-10-S08~~1~~

2. DID Title: Safety and Mission Assurance (S&MA) Plan

3. Approval Required Yes__X__ No _____

4. Initial Submittal Date: May 15, 1996

5. Update Frequency: N/A

6. Number of Copies:
   6.1 English version: 1
   6.2 Russian version: N/A

7. Preparation information:

7.1 Use: To define NASA planned method of accomplishing S&MA task required to show compliance with requirements in SSP 41000 and NASA/RSA Bilateral S&MA Process Requirements for ISS for all NASA provided contributions to the ISS.

7.2 Content: The S&MA Plan shall address the philosophy, organization , approach and processes for all aspects of Safety, Reliability, Maintainability, Quality Assurance, and Software Quality Assurance programs. The plan should include all stages to the program including design, manufacture and test, certification and verification, flight test, operations, and document control.

7.2a. Safety Plan: The Safety Plan shall define the methodology and techniques for achieving safety requirements. This will be a description of how the safety program will be conducted to meet the design requirements and process requirements. The plan shall include, as a minimum, the following:

1. An identification of each task, as defined in other DIDs to be accomplished under the safety program.
2. A description of how each task will be performed
3. The procedures (where existing procedures are applicable) to evaluate the status and control of each task
4. The identification of the organization unit with the authority and responsibility for executing each task

7.2b. Reliability Plan: The Reliability Plan shall define the methodology and techniques for achieving Reliability requirements. This will be a description of how the Reliability program will be conducted to meet the design requirements and process requirements. The plan shall include, as a minimum, the following:

1. An identification of each task, as defined in other DIDs to be accomplished under the Reliability program.
2. A description of how each task will be performed
3. The procedures (where existing procedures are applicable) to evaluate the status and control of each task
4. The identification of the organization unit with the authority and responsibility for executing each task

7.2c. Maintainability Plan: The Maintainability Plan shall define the methodology and techniques for achieving Maintainability requirements. This will be a description of how the Maintainability program will be conducted to meet the design requirements and process requirements. The plan shall include, as a minimum, the following:

1. An identification of each task, as defined in other DIDs to be accomplished under the Maintainability program.
2. A description of how each task will be performed
3. The procedures (where existing procedures are applicable) to evaluate the status and control of each task
4. The identification of the organization unit with the authority and responsibility for executing each task

7.2d. Quality Assurance Plan: The Quality Assurance Plan shall define the methodology and techniques for achieving Quality Assurance requirements. This will be a description of how the Quality Assurance program will be conducted to meet the design requirements and process requirements. The plan shall include, as a minimum, the following:

1. ORGANIZATION
2. PLANNING FOR ON-ORBIT ACTIVITIES
3. TRAINING
4. INTERNAL QUALITY PROGRAM AUDITS AND SURVEYS
5. MILESTONE REVIEWS
6. DESIGN AND DEVELOPMENT CONTROLS
7. CHANGE CONTROL VERIFICATION
8. PRODUCT/PROCESS DEVELOPMENT AND VALIDATION
9. IDENTIFICATION AND DATA RETRIEVAL
10. RETENTION OF RECORDS
11. SUPPLIER/PROCUREMENT CONTROLS
12. RECEIVING INSPECTION
13. AUDITS AND SURVEYS OF PROCUREMENT SOURCE OPERATIONS
14. FABRICATION CONTROLS

15. ARTICLE AND MATERIAL CONTROLS
16. CLEANLINESS/CONTAMINATION CONTROL
17. PROCESS CONTROLS
18. NONDESTRUCTIVE EVALUATION (NDE)
19. WORKMANSHIP STANDARDS
20. CONTROL OF TEMPORARY INSTALLATIONS AND REMOVALS
21. TEST CONTROLS
22. INSPECTION AND TEST RECORDS AND DATA
23. NONCONFORMANCE CONTROL SYSTEM
24. PROBLEM REPORTING
25. METROLOGY
26. HANDLING, STORAGE, PRESERVATION, MARKING, LABELING, PACKAGING, PACKING, AND SHIPPING
27. SAMPLING PLANS, STATISTICAL PLANNING, AND ANALYSES

7.2e. Software Quality Assurance The Software Quality Assurance Plan shall define the methodology and techniques for achieving Software Quality Assurance requirements. This will be a description of how the Software Quality Assurance program will be conducted to meet the design requirements and process requirements. The plan shall include, as a minimum, the following:

1. An identification of each task, as defined in other DIDs to be accomplished under the Software Quality Assurance program.
2. A description of how each task will be performed
3. The procedures (where existing procedures are applicable) to evaluate the status and control of each task
4. The identification of the organization unit with the authority and responsibility for executing each task

7.3 Format: The S&MA Plan will be organized by the major functions of S&MA. Organization with a separate volume for each discipline area will permit each volume to be revised and approved (i.e., Safety, Reliability, Maintainability, Quality Assurance, and Software Quality Assurance.

DATA ITEM DESCRIPTION (DID)

1. DID Number: R-10-S02

2. DID Title: Hazard Reports and System Description

3. Approval Required: Yes__X__ No_____

4. Initial Submittal Date: 45 days prior to Phase 1 safety review (see schedule included in NASA/RSA Safety Review Process for ISS) for element specific data
(See table attached)

5 Update Frequency: 45 days prior to each phase safety review for elements
(See table attached)

6 Number of Copies:
6.1 English version: N/A
6.2 Russian version: 1

7. Use: The ISS SRP will use the Hazard Reports and System Description to assess the design and operation of ISS element hardware configuration.

8. Preparation Information:

8.1 Scope: R-10-S02 shall consist of hazard reports and system descriptions for all Russian flight hardware. Additionally, R-10-S02 shall document integrated hazard analyses for the overall Russian Segment.

8.2 Format: These deliverables shall be in the format agreed-upon in the NASA/RSA Safety Review Process.

8.3 Content: Hazard Reports and System Descriptions shall be provided that are commensurate with the level of maturity of the design.

8.3.1 System Description: RSA shall provide a description of the on-orbit configuration of the hardware and software in accordance with NASA/RSA Safety Review Process for ISS. Functional diagrams shall be submitted and supplemented with descriptions of interfaces and operations. When this data has been previously provided to NASA by RSA, it is acceptable to use the documents containing design and system descriptions. If necessary, additional data shall be provided.

8.3.2 Hazard Reports: Hazard Reports/Off-nominal Situations shall be done in accordance with NASA/RSA Safety Review Process for ISS. For Phase I maturity, Hazard Reports shall reflect the preliminary design review level of detail that define hazards causes, and provide the preliminary hazard controls. Additionally, preliminary verification methods when available should be included. For Phase II maturity, the Hazard Reports shall be updated to reflect the critical design level of detail and define the finalized hazard controls and verification methods. For Phase III, the Hazard Reports shall be updated to reflect the as-built design and document completion of verification.

Service Module	Initial Report (due 45 days prior to Phase 0 SRP)
Service Module	Interim Report (due 45 days prior to Phase 1 SRP)
Service Module	Interim Report (due 45 days prior to Phase 2 SRP)
Service Module	Final Report (due 45 days prior to Phase 3 SRP)
FGB	Initial Report (due 45 days prior to Phase 1 SRP)
FGB	Interim Report (due 45 days prior to Phase 2 SRP)
FGB	Final Report (due 45 days prior to Phase 3 SRP)
UDM	Initial Report (due 45 days prior to Phase 1 SRP)
UDM	Interim Report (due 45 days prior to Phase 2 SRP)
UDM	Final Report (due 45 days prior to Phase 3 SRP)
DC	Initial Report (due 45 days prior to Phase 1 SRP)
DC	Interim Report (due 45 days prior to Phase 2 SRP)
DC	Final Report (due 45 days prior to Phase 3 SRP)
Soyuz	Initial Report (due 45 days prior to Phase 0 SRP)
Soyuz	Interim Report (due 45 days prior to Phase 1 SRP)
Soyuz	Interim Report (due 45 days prior to Phase 2 SRP)
Soyuz	Final Report (due 45 days prior to Phase 3 SRP)
Progress	Initial Report (due 45 days prior to Phase 0 SRP)
Progress	Interim Report (due 45 days prior to Phase 1 SRP)
Progress	Interim Report (due 45 days prior to Phase 2 SRP)
Progress	Final Report (due 45 days prior to Phase 3 SRP)
SPP	Initial Report (due 45 days prior to Phase 1 SRP)
SPP	Interim Report (due 45 days prior to Phase 2 SRP)
SPP	Final Report (due 45 days prior to Phase 3 SRP)
LTV	Initial Report (due 45 days prior to Phase 1 SRP)
LTV	Interim Report (due 45 days prior to Phase 2 SRP)
LTV	Final Report (due 45 days prior to Phase 3 SRP)
DSM	Initial Report (due 45 days prior to Phase 1 SRP)
DSM	Interim Report (due 45 days prior to Phase 2 SRP)
DSM	Final Report (due 45 days prior to Phase 3 SRP)
Research M-1	Initial Report (due 45 days prior to Phase 1 SRP)
Research M-1	Interim Report (due 45 days prior to Phase 2 SRP)
Research M-1	Final Report (due 45 days prior to Phase 3 SRP)
Research M-2	Initial Report (due 45 days prior to Phase 1 SRP)
Research M-2	Interim Report (due 45 days prior to Phase 2 SRP)
Research M-2	Final Report (due 45 days prior to Phase 3 SRP)

Research M-3	Initial Report (due 45 days prior to Phase 1 SRP)
Research M-3	Interim Report (due 45 days prior to Phase 2 SRP)
Research M-3	Final Report (due 45 days prior to Phase 3 SRP)
LSM	Initial Report (due 45 days prior to Phase 1 SRP)
LSM	Interim Report (due 45 days prior to Phase 2 SRP)
LSM	Final Report (due 45 days prior to Phase 3 SRP)

DATA ITEM DESCRIPTION (DID)

1. DID Number: R-10-S03

2. DID Title: Mishap and Investigation Reports

3. Approval Required: Yes____ No___X__

4. Initial Submission: Within one week of occurrence (by telephone or written notification).

5. Frequency of Submission: As required.

6. Number of Copies:
   6.1 English version: N/A
   6.2 Russian version: 1

7. Use: Provide notification and status of investigation of accidents or incidents related to the RS of the ISS Program. To provide technical assistance to NASA and RSA boards investigating mishaps that are within their jurisdiction.

8. Preparation Information:

8.1 Scope: RSA Mishap reports shall encompass ISS Program mishaps occurring during manufacturing, testing, and operational period. The RSA organizations shall provide records and other administrative or technical support to review boards investigating mishaps.

A mishap is defined as any unplanned occurrence, event, or anomaly. Mishaps that should be reported to NASA by RSA include those mishaps that may have significant program impact, may affect schedule, or cause death or permanent injury of crew or non-Russian ground personnel.

8.2 Format: The mishap report is to be done in the RSA format.

DATA ITEM DESCRIPTION (DID)

1. DID Number: U-10-S093

2. DID Title: Mishap and Investigation Reports

3. Approval Required: Yes____ No___X__

4. Initial Submission: Within one week of occurrence (by telephone or written notification).

5. Frequency of Submission: As required.

6. Number of Copies:
6.1 English version: 1
6.2 Russian version: N/A

7. Use: Provide notification and status of investigation of accidents or incidents related to the USOS of the ISS Program. To provide technical assistance to NASA and RSA boards investigating mishaps that are within their jurisdiction.

8. Preparation Information:

8.1 Scope: NASA Mishap reports shall encompass ISS Program mishaps occurring during manufacturing, testing, and operational period. The NASA organizations shall provide records and other administrative or technical support to review boards investigating mishaps.

A mishap is defined as any unplanned occurrence, event, or anomaly. Mishaps that should be reported to RSA by NASA include those mishaps that may have significant program impact, may affect schedule, or cause death or permanent injury of crew or ground personnel.

8.2 Format: The mishap report is to be done in the NASA format.

DATA ITEM DESCRIPTION (DID)

1. DID Number: R-10-S04

2. DID Title: Integrated Safety Data

3. Approval Required: Yes ____ No __x__

4. Initial Submittal: RSA: June 01, 1996 (for Stage 2R)TBD

5. Update Frequency: RSA: 90 days prior to each phase of each IDR Element Integrated Stage Safety Review

6. Number of Copies: 1 each (in native format)

7. Preparation information:

7.1 PURPOSE/USE: Identification and tracking of integrated hazards, their resolution, control actions, and status.

7.2 SCOPE: All hazards that have an effect on the interfaces or USOS/IP elements. All hazards that cannot be fully controlled within RS. Data will be provided at a level equivalent to the hazard analysis provided to the SRP prior to the submittal.

7.3 DESCRIPTION:

RSA will provide:

1. Hazards and off-nominal situations descriptions for RS hazards which affect the interface or USOS/IP elements.
2. List of causes identified (at the time of submittal) during the RS hazard analysis that will require one or more controls from the USOS to assure ISS safety.
3. Description of how the agreed-upon controls requested by the USOS/IP will be implemented on the RS.

- For Phase 1 IDR review:
  - Data outlined above with sufficient detail for a Phase 1 Safety Review as defined in "NASA/RSA Safety Review Process"

  Hazard data:
  - Failures which affect the interface or other elements
  - Identification of additional controls required from other elements to meet total safety failure tolerance requirements
  - Implementation of controls required by USOS/IP elements or ISS partners
- For Phase 2 IDR review:
  - Update of Phase 1 data consistent with requirements defined in "NASA/RSA Safety Review Process"
- For Phase 3 IDR review:

- Update of Phase 2 data with status of verification and open work as defined in "NASA/RSA Safety Review Process"

8. FORMAT: Native format is acceptable.

DATA ITEM DESCRIPTION (DID)

1. DID Number: U-10-S05

2. DID Title: Integrated Safety Data

3. Approval Required: Yes ____ No __x__

4. Initial Submittal: NASA/Boeing: March 30, 1996

5. Update Frequency: NASA/Boeing: 135 days prior to each phase of each IDR Safety Review

6. Number of Copies: 1 each (in native format)

7. Preparation information:

7.1 PURPOSE/USE: Identification and tracking of integrated hazards, their resolution, control actions, and status.

7.2 SCOPE: All hazards that have an effect on the interfaces or RS elements. All hazards that cannot be fully controlled within US/IP segment.

7.3 DESCRIPTION:

NASA/Boeing will provide to RSA:

1. Boeing-Prime integrated hazard reports
2. Boeing-Prime integrated logic tree
3. Detailed recommending list of ISS hazards and causes requiring controls partially on USOS and partially on RS.

- For Phase 1 IDR review:
  - Data outlined above with sufficient detail for a Phase 1 Safety Review as defined in "NASA/RSA Safety Review Process"

  Hazard data:
  - Failures which affect the interface or other elements
  - Identification of additional controls required from other elements to meet total safety failure tolerance requirements
  - Implementation of controls required by RS elements
- For Phase 2 IDR review:
  - Update of Phase 1 data consistent with requirements defined in "NASA/RSA Safety Review Process"
- For Phase 3 IDR review:
  - Update of Phase 2 data with status of verification and open work as defined in "NASA/RSA Safety Review Process"

8. FORMAT: Native format is acceptable.

DATA ITEM DESCRIPTION (DID)

1.	DID Number:	R-10-S06
2.	DID Title:	Logic Tree Development
3.	Approval Required:	Yes____ No __x__
4.	Initial Submittal:	TBD
5.	Update Frequency:	90 days prior to each phase of each IDR Element Integrated Stage Safety Review
6.	Number of Copies:	1 in English
7.	Preparation information:	
	7.1 PURPOSE/USE:	Identification and tracking of hazards, their causes.
	7.2 SCOPE:	All hazards that have an effect on the interfaces or other elements. All hazards that cannot be fully controlled within that segment.
	7.3 DESCRIPTION:	RSA will provide to NASA: • Additions/corrections to the integrated logic tree
8.	FORMAT:	Consistent with the format of the Boeing developed Logic tree as developed using CAFTA software.

DATA ITEM DESCRIPTION (DID)

1.	DID Number:	U-10-S07
2.	DID Title:	Logic Tree Development
3.	Approval Required:	Yes____ No __x__
4.	Initial Submittal:	September 1995
5.	Update Frequency:	135 days prior to each phase of each IDR Safety Review
6.	Number of Copies:	1 in English
7.	Preparation information:	
	7.1 PURPOSE/USE:	Identification and tracking of hazards, their causes.
	7.2 SCOPE:	All hazards that have an effect on the interfaces or other elements. All hazards that cannot be fully controlled within that segment.
	7.3 DESCRIPTION:	NASA/Boeing will provide to RSA: • Boeing-Prime integrated logic tree for each stage of ISS
8.	FORMAT:	Consistent with the format of the Boeing developed Logic tree as developed using CAFTA software.

DATA ITEM DESCRIPTION (DID)

1. Data Requirement Number: R-10-R01

2. Data Requirement Title: Failure Mode Summary Report (FMSR)

3. Approval Required: Yes____ No __x___

4. Initial Submittal: September 30, 1996

5. Update Frequency: As required, per Bilateral Protocols

6. Number of Copies:

6.1 ENGLISH VERSION:__N/A__
6.2 RUSSIAN VERSION:___1___

7. SOW Reference: N/A

8. Electronic Delivery Required: Yes

9. Purpose: To document the cases of non-compliance with the specification requirements concerning reliability, to identify critical items.

10. Preparation Information:

FMSR for each module shall contain the list of all items with single failures of which the specification requirements of failure tolerance and failure propagation are not fulfilled. Failure propagation is assumed to be violated if failure effects, as manifested at the RS/USOS interfaces, are outside specified interface conditions. The list shall include items whose single failure causes an effect on the ability of the RS/USOS to perform the specified capabilities within the RS/USOS specification. (For capabilities allowed to exhibit degraded performance, this is defined as inability to deliver specified life and station critical functionality and specified interface conditions to the USOS/RS.) The following information is given for every item of such type:

1. Item's title and designation
2. Item's capability (function)
3. System in which the item is utilized
4. Impact of item's failure on:
    4.1 Capability, mentioned in paragraph 3.2.3.1, Failure tolerance requirements of the USOS/RS specification.
    4.2 Interfaces with ISS other modules (systems)
    4.3 Crew/ISS safety

5. Approximate time to effect (instantly, seconds, minutes, etc.)
6. Approximate time to detect (instantly, seconds, minutes, etc.)
7. Approximate time to restore (instantly, seconds, minutes, etc.)

The RS shall consider the effects on hardware in the event of failure effect on the other side of the interface. The interface conditions shall be evaluated/analyzed by the receiving segment/system for possible damage to equipment. The results shall be documented in the respective FMSR.

Service Module	Initial Report
Service Module	Update Report
FGB	Initial Report
FGB	Update Report
UDM	Initial Report
UDM	Update Report
DC	Initial Report
DC	Update Report
SPP	Initial Report
SPP	Update Report
LTV	Initial Report
LTV	Update Report
DSM	Initial Report
DSM	Update Report
Research M-1	Initial Report
Research M-1	Update Report
Research M-2	Initial Report
Research M-2	Update Report
Research M-3	Initial Report
Research M-3	Update Report
LSM	Initial Report
LSM	Update Report

DATA ITEM DESCRIPTION

1. DID Number: U-10-R05~~1~~

2. DID Title: Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL)

3. Frequency of Submission: Formal electronic update 30 days prior to Program Design Reviews

4. First Submission Date: 30 days prior to the first IDR, electronically available

5. Copies and Distribution: 1 copy in English

8. Remarks: N/A

9. Use: The FMEA serves as a source that documents the systematic evaluation by item failure mode analyses, the potential impact of each functional or hardware failure on mission success, personnel, and systems safety, system performance, maintenance, and maintainability requirements. Each potential failure is assessed in order that appropriate corrective action(s) may be taken to eliminate or control the high risk items. The CIL documents the item's inability to meet program requirements.

10. References:

(a) Statement of Work (SOW); paragraph 1.7.1.a.(3)
(b) SSP 30234, Failure Modes, Effects, and Criticality Analysis

11. Interrelationships: DRs SM05 and VE32

12. Preparation Information:

12.1 Scope: The FMEA/CIL shall be performed on program hardware to the equipment level consistent with the identified on-orbit maintenance level and ground support equipment as specified in SSP 30234.

12.2 Format: The data element format shall be as specified in SSP 30234.

12.3 Content: The FMEA/CIL contents are specified by SSP 30234.

12.4 Maintenance: The worksheets shall be maintained electronically.

DATA ITEM DESCRIPTION

1. DATA REQUIREMENT NUMBER: R-10-R02

2. DATA REQUIREMENT TITLE: Reliability & Maintainability Predictions Report

3. APPROVAL REQUIRED: Yes_____NO___X___

4. INITIAL SUBMITTAL DATE: June 1996, Preliminary data January 1996

5. UPDATE FREQUENCY: For each stage of the ISS, as required.

6. NUMBER OF COPIES:

6.1 ENGLISH VERSION:__N/A__
6.2 RUSSIAN VERSION:___1___

7. SOW REFERENCE N/A

8. ELECTRONIC DELIVERY REQUIRED: YES_X__ NO_____

9. PURPOSE: Reliability and Maintenance predictions data shall be used to status quantitative R&M characteristics of Space Station functions, capabilities, and equipment. The quantitative predictions data are used to estimate the probability that an item will perform its required functions during the mission and to estimate the end of service life. The predictions also estimate the demand for maintenance and identify areas where special emphasis or attention is needed.

10. PREPARATION INFORMATION:

10.1 REFERENCE DOCUMENTS:
10.2 DATA DESCRIPTION (CONTENTS): The R&M predictions report shall document information related to critical Space Station functions (As defined in the NASA/RSA Bilateral Process Requirements Document, Attachment A, and below) and the interfaces between segments. The reports shall consist of :

Reliability:
1) An estimate of overall functional reliability for each critical Station function.
2) A report which describes the system or systems included in the estimates.

Maintainability
1) An estimate of crew maintenance time per year for IVA, EVA and EVR maintenance for each stage of the ISS, and for all ISS equipment utilized at assembly complete.

10.3 DATA REQUIREMENT SPECIFIC FORMAT : The analysis shall be submitted in the native RSA format.

11.0 DEFINITIONS : Critical functions for estimating the reliability of the Space Station are as follows:

1. Determine navigational parameters

2. Maintain attitude - non propulsive

3. Control attitude - propulsive

4. Execute translation maneuvers

5. Maintain habitable atmosphere

6. Provide Electrical Power

7. Maintain thermal conditioning

8. Provide command and data handling

9. Support on orbit - ground communications

10. Support Space Station to external vehicle communication

11. Support assured crew return

Service Module	Initial Report
Service Module	Update Report
FGB	Initial Report
FGB	Update Report
UDM	Initial Report
UDM	Update Report
DC	Initial Report
DC	Update Report
Soyuz	Initial Report
Soyuz	Update Report
Progress	Initial Report
Progress	Update Report
SPP	Initial Report

SPP	Update Report
LTV	Initial Report
LTV	Update Report
DSM	Initial Report
DSM	Update Report
Research M-1	Initial Report
Research M-1	Update Report
Research M-2	Initial Report
Research M-2	Update Report
Research M-3	Initial Report
Research M-3	Update Report
LSM	Initial Report
LSM	Update Report

DATA ITEM DESCRIPTION

1. DID Number: U-10-R06~~2~~

2. DID Title: R&M Predictions Report

3. Frequency of Submission: Formal updates 30 days prior to Program Design Reviews

4. First Submission Date: 30 days prior to the first IDR

5. Copies and Distribution: 1 copy in English

6. Use: The S&MA allocations, assessments, and analysis reports shall be used to identify, validate and status quantitative and qualitative S&MA allocation and performance characteristics of space station function and equipment and to document preventive maintenance requirements and limited life items.

7. Preparation Information:

7.1 Scope: This report shall provide requirement allocations, predictions, trade studies, and analysis for the space station system according to designated capabilities, functions, and on-orbit repairable items. Predicted S&MA performance shall be documented according to capability, function, and on-orbit repairable item for each stage of the assembly sequence.

7.2 Format: These reports shall be delivered in the Contractor's format.

7.3 Content: The S&MA allocations, assessments, and analysis report shall document the program status and progress in executing the S&MA requirements and objectives. The report shall contain the following:

(a) S&MA Requirements Compliance Summary
  (1) Compare predictions to allocations
  (2) Assess compliance at system, segment, function, and CI level
  (3) Identify percent compliant, percent non-compliant and percent TBD
  (4) Define areas of non-compliance, level, rationale, and corrective action

(b) S&MA Qualitative Assessments

  (1) Provide ground rules and assumptions used in assessments
  (2) Identify methods/tools used in performing assessments
  (3) Provide results summary, conclusions and recommendations

(c) S&MA Trade Studies

  (1) Identify associated ground rules and assumptions used in study

(2) Define trade candidates and characteristics/features that were evaluated
(3) Provide S&MA position (e.g., preferred design option)
(4) Summarize decision rationale used in the option selection

(d) S&MA Quantitative Predictions and Analyses

(1) Define the approach/process used and levels of reserve (where applicable).
(2) Identify associated ground rules and assumptions used in making predictions and performing analyses .
(3) Define prediction techniques, methodologies and tools.
(4) Provide EVA, EVR, and IVA crew maintenance time predictions for corrective and preventive maintenance to demonstrate compliance with allocations.
(5) Provide EVA, EVR, and IVA overhead maintenance time predictions for corrective and preventive maintenance
(6) Provide maintenance action rate predictions
(7) Provide summaries of major contributors to probability of failure, crew maintenance time, safety hazards
(8) Provide percentages of detecting failures modes at the capability, function and on-orbit maintainable equipment item level
(9) Provide percentages of failure modes capable of being isolated to a single maintainable equipment item and to the ambiguity group
(10) Provide source data used in analysis
(11) Identify prediction data fidelity levels
(12) Provide reliability block diagrams and associated data
(13) Provide a summary table of current reliability (probability of success) predictions to demonstrate compliance with requirements.

(e) S&MA Assembly Analysis

(1) Define the approach/process used and levels of reserve (where applicable).
(2) Identify associated ground rules and assumptions used in making predictions and performing analyses.
(3) Define prediction techniques, methodologies and tools.
(4) Provide EVA, EVR, and IVA crew maintenance time predictions for corrective and preventive maintenance by flight.
(5) Provide EVA, EVR, and IVA overhead maintenance time predictions for corrective and preventive maintenance.
(6) Provide maintenance action rate predictions by flight.
(7) Provide percentage of detecting failures modes by stage at the capability, function and on-orbit maintainable equipment item level.
(8) Provide percentage of failure modes capable of being isolated to a single maintainable equipment item and to the ambiguity group.
(9) Provide manifest and activation flights of all on orbit maintainable items.
(10) Provide reliability block diagrams and associated data by stage.
(11) Provide a summary table of current reliability predictions by stage.

(f) Preventive Maintenance

(1) Define the approach and process used to define preventive maintenance requirements.
(2) Identify ground rules and assumptions.
(3) Provide preventive maintenance requirements and rationale.

7.4 Maintenance: These reports shall be maintained electronically.

DATA ITEM DESCRIPTION

1. DATA REQUIREMENT NUMBER: R-10-R03

2. DATA REQUIREMENT TITLE: Critical Item List (CIL)

3. APPROVAL REQUIRED: Yes note 1 NO_____
Note 1: Document requires ISS program approval.

4. INITIAL SUBMITTAL DATE: SEPTEMBER 30, 1996

5. UPDATE FREQUENCY: As Required, per Bilateral Protocols

6. NUMBER OF COPIES:
6.1 NATIVE VERSION: 1 .

7. SOW REFERENCE: **N/A**

8. ELECTRONIC DELIVERY REQUIRED: **YES**____X____
NO_____

9. PURPOSE: The CIL shall document failure modes of equipment and single failure points. The purpose is to support risk assessment, additional design action, safety analysis, preparation of mandatory inspection points, hardware/software interface analyses, test planning, maintainability analysis and planning, and logistics planning.

10. PREPARATION INFORMATION:

10.1 REFERENCE DOCUMENTS: SSP 30234 REV A

10.2 DATA DESCRIPTION (CONTENTS):

A critical item list shall be developed for all criticality 1, 1S, and 1P items. The CIL will also include criticality 1R items which fail the redundancy screens. Critical Item criticality categories are defined as:

Criticality 1

Those single failure points that could result in loss of Space Station of loss or flight personnel.

Criticality 1S

A single failure point of the system component designed to provide safety of protection capability against a potentially hazardous condition or event or a single failure point in a safety or hazard monitoring system that causes the system to fail to detect, or operate when needed during the existence of a hazardous condition that could lead to loss of flight personnel or Space Station.

Criticality 1P

A single failure point which is protected by a safety device, whereby the proper functioning of the safety device, would prevent the hazardous consequences of the failed (protected) component.

Criticality 1R items that fail one of the redundancy screens below

Criticality 1R items are those redundant items, all of which if failed, could result in loss of Space Station of loss of flight personnel. Note: For purpose of CIL Identification, both the flight and ground detection screens must be failed for the item to be identified as a CIL (reference SSP 30234)

At a minimum the CIL shall be prepared to the assembly level at which the item is repaired or replaced. The CIL shall be prepared for each individual module in the Russian segment and shall contain the following data elements as a minimum (note: FGB CILs will be prepared according to separate contract requirements):

Item name (14)* - Nomenclature and part number of the item being analyzed.

Item function - The function of the item under analysis.

Type of Redundancy - Indication whether the redundancy is active or standby. Indicate the level of redundancy(example 2 of 3 required).

System Name - Name of the system the item is associated with.\

System function - The function(s) of the system the item failure mode affects. Reference functions described in Table IX of the Russian Segment Specification, SSP 41163.

Failure mode text (29)* - Additional description of the failure mode under analysis, i.e.,

1. Premature operation;
2. Failure to operate within specification or failure to operate at a prescribed time;
3. Failure during operation, including failure to contain or store energy or fluids;
4. Failure to cease operations at a prescribed time.

Criticality category (31)* - Criticality for the worst case effect

Failure detection (35)* - How the failure mode for the item would be detected and verified.

Time to detect (36A&B)* - Time expressed as seconds, minutes, hours, days, weeks or months that describe the estimated time from failure occurrence to detection of the failure by the crew.

Failure effect on - Crew/ISS (44)* - Worst case failure mode effect on the crew/ISS /Orbiter

Time to effect (45A&B)* - Estimated time from failure occurrence to manifestation of worst case failure mode effects. Expressed as seconds, minutes, hours, days, weeks or months

Redundancy screen

- Checkout Prelaunch(49)* - Indication for redundant items if they have passed or failed the redundancy screen. Indicates if redundant item can be checked out without maintenance.
- Checkout on-orbit(50)* - Indication for redundant items if they have passed or failed the redundancy screen. Indicates if inactive redundant item can be checked out without maintenance.
- Detection Flight Crew (51)* - Indication for redundant items if they have passed or failed the redundancy screen. Indicates if the failure mode can be detected by the flight crew during any mission phase.
- Detection Ground Control (52)* - Indication for redundant items if they have passed or failed the redundancy screen. Indicates if the failure mode can be detected by the ground crew during any mission phase.
- Loss of Redundancy from a Single Cause (53)* - Indication for redundant items if they have passed or failed the redundancy screen. Indicates that all redundant items could not be lost by a single credible event or cause (excludes fire or M/OD).

Hazard number (56A)* - Reference to the applicable hazard report (where a hazard analysis exists)

Retention rationale:

- design (73)* - Specific design features which minimize the probability of occurrence of the failure mode and its causes.
- test (74)* - Specific testing which will be accomplished which supports the premise that the critical failure mode/cause has been addressed properly.
- inspection (77)* - Specific inspection points and critical process controls implemented

to minimize the probability that the points and critical process controls implemented to minimize the probability that the failure mode causes will occur in the system.

- failure history (78)* - Summary of information relative to the performance history of the hardware for the failure mode. Include only failures from acceptance testing of modules and in-flight operation of the item
- operational use (79)* - Description of the crew and/or ground personnel operations used to mitigate the failure's effect. (May reference hazard reports)
- maintainability (80)* - Describe the possibility of performing maintenance or repair of the item prior to the occurrence of the failure effects. Discuss the availability of spare items on the ground or in orbit. Identification of specific maintainability verifications performed (analysis or flight test). Identify level of repair/replacement.

* Note: The number in parenthesis refers to SSP 30234 Appendix C data element.

10.3 FORMAT: Each submittal shall have a discrete title page stating :
TBD

10.4 DATA REQUIREMENT SPECIFIC FORMAT AND PREPARATION INSTRUCTIONS:
10.4.1 RSA shall perform appropriate failure analysis and document the following:
- Assumptions and ground rules used in the analysis
- Summary report of analysis
- CILs

Data Submittals:

Service Module	Initial Report
Service Module	Update Report
FGB	Initial Report
FGB	Update Report
UDM	Initial Report
UDM	Update Report
DC	Initial Report
DC	Update Report
SPP	Initial Report
SPP	Update Report
LTV	Initial Report
LTV	Update Report
DSM	Initial Report
DSM	Update Report
Research M-1	Initial Report
Research M-1	Update Report
Research M-2	Initial Report
Research M-2	Update Report
Research M-3	Initial Report
Research M-3	Update Report
LSM	Initial Report
LSM	Update Report

DATA ITEM DESCRIPTION

1. DID NUMBER: R-10-QA01
2. DID TITLE Failure Reporting and Corrective Action

3. APPROVAL REQUIRED YES ____ NO__X__

4. INITIAL SUBMITTAL DATE: For on orbit failures and failures which may affect program schedule, failure reports shall be issued within 15 days of occurrence. For others, failure reports shall be delivered 5 days prior to FRR or equivalent review.

5. UPDATE FREQUENCY: Initial report; final report following satisfactory resolution of problem

6. NUMBER OF COPIES:
6.1 ENGLISH VERSION:__N/A__
6.2 RUSSIAN VERSION:___1___

7. SOW REFERENCE __N/A__

8. ELECTRONIC DELIVERY REQUIRED: YES ____ NO __X__

8.1 ELECTRONIC FORMAT REQUIRED: __N/A__

9. PURPOSE: To provide a system for failures reporting and recurrence control for flight and test hardware.

10. PREPARATION INFORMATION:
10.1 REFERENCE DOCUMENTS: __N/A__

10.2 DATA DESCRIPTION (CONTENTS): The following types of failures shall be reported:

On Orbit: All failures with effect on US/RS interface, or effect on a critical function. (defined in NASA/RSA Bilateral Process Requirements Document, Attachment A).

Prior to launch: 1) All problems which could affect Program schedule. 2) All unresolved problems, which affect critical functions or USOS/RS ICD limits, and which remain unresolved at FRR or equivalent.

A report shall be prepared and submitted for each failure as described above. The Failure Reports shall include the following as a minimum:

a. Identification of the failed component,
b. The date and the site location that the nonconformance/problem was detected,
c. The situation under which the nonconformance/problem was observed and the actions taken as a result of the failure,
d. A description of the failed component,
e. Cause of the failure,
f. Failure effect, or information concerning events which may be impacted as a result of the nonconformance/problem,
g. The corrective action(s) taken to resolve the nonconformance/problem,
h. Actions taken to prevent reoccurrence on similar hardware, and
i. Results of testing/inspection to ensure that the nonconformance/problem was corrected.

DATA REQUIREMENT SPECIFIC FORMAT AND PREPARATION INSTRUCTIONS:
Native format is acceptable

DATA ITEM DESCRIPTION

1. DID NUMBER: U-10-QA03~~1~~
2. DID TITLE Failure Reporting and Corrective Action

3. APPROVAL REQUIRED YES ____ NO__X__

4. INITIAL SUBMITTAL DATE: Within 5 days of occurrence

5. UPDATE FREQUENCY: Initial report; final report following satisfactory resolution of problem
6. NUMBER OF COPIES:
6.1 ENGLISH VERSION:__1
6.2
RUSSIAN VERSION:_N/A_____
7.
SOW REFERENCE __N/A__
8. ELECTRONIC DELIVERY REQUIRED: YES _X___ NO ____
8.1 ELECTRONIC FORMAT REQUIRED: __Y__

9. PURPOSE: To provide a system for failures reporting and recurrence control for flight and test hardware.

10. PREPARATION INFORMATION:
10.1 REFERENCE DOCUMENTS: SSP 30223

10.2 DATA DESCRIPTION (CONTENTS):
A report shall be prepared and submitted for each failure encountered in accordance with SSP 30223. The Failure Reports shall include the following as a minimum:

a. Identification of the failed component,
b. The date and the site location that the nonconformance/problem was detected,
c. The situation under which the nonconformance/problem was observed and the actions taken as a result of the failure,
d. A description of the failed component,
e. Cause of the failure,
f. Failure effect, or information concerning events which may be impacted as a result of the nonconformance/problem,
g. The corrective action(s) taken to resolve the nonconformance/problem,
h. Actions taken to prevent reoccurrence on similar hardware, and
i. Results of testing/inspection to ensure that the nonconformance/problem was corrected.

10.3 DATA REQUIREMENT SPECIFIC FORMAT AND PREPARATION INSTRUCTIONS: Native format is acceptable

ATTACHMENT C - NASA/RSA SAFETY REVIEW PROCESS FOR ISS

NASA /RSA SAFETY REVIEW PROCESS FOR ISS

ATTACHMENT C TABLE OF CONTENTS

1.0 INTRODUCTION

NASA has developed an ISS Safety Review Process to execute its responsibilities for the overall integrated safety of
the ISS. That process is defined in SSP 30599. The NASA /RSA safety review process defined herein reflects the bilateral agreements between NASA and RSA which will implement the intent of the ISS Safety Review Process. Likewise, NASA has defined a set of technical safety requirements to be implemented throughout the design of the ISS. These technical requirements are defined in SSP 50021, Safety Requirements for International Space Station Alpha. As amended by bilateral NASA and RSA agreements the technical intent of the safety requirements of SSP 50021 have been incorporated into SSP 41163, Russian Segment Specification.

1.1 PURPOSE AND SCOPE

The purpose of the NASA/ RSA safety review process is to define the methodology by which ISS will review and assess the safety of the RS flight elements and support equipment that will become part of the ISS. RS elements and ground support equipment that are used at KSC are also subject to the ISS safety review process. The safety of the Russian ground elements and support equipment that are used
at Russian ground and launch facilities are the responsibility of RSA and are outside the scope of this document.

This process agreement describes the responsibilities of the organizations involved in the safety review process and the phase safety review meeting requirements.

The Soyuz and Progress vehicles are existing and proven designs, and as such, the scope of the safety review for those vehicles may differ from the other elements of the RS. Appendix A of this document specifies exceptions to the safety review process that are applicable to the Russian Vehicles (Soyuz and Progress).

2.0 APPLICABLE DOCUMENTS

SSP 50094 NASA /RSA Joint Specification/Standards Document for ISS Russian Segment

SSP 41163 Russian Segment Specification

2.1 REFERENCE DOCUMENTS

SSP 30599 Safety Review Process

SSP 50021 Safety Requirements for ISS

3.0 RESPONSIBILITIES

NASA is responsible for the overall integrated safety of the ISS. To successfully implement this responsibility compliance with the safety requirements must be assured within the ISS Program by the close coordination of a well structured phase safety review process with the formal ISS design review process. This coordinated review provides the mechanisms necessary to demonstrate that all hazards have been identified and once identified have been sufficiently controlled, eliminated or reduced by appropriate design features. At the completion of the safety review process there must be assurance that the residual risks are acceptable and that all hazard controls are properly verified. In consideration of the cultural differences in the NASA and Russian approaches to safety, the ISS safety review process has been adapted to review a modified version of Russian off-nominal situations (ONSs). This approach will enhance safety in that RSA will be able to utilize a safety tool with which it has experience and still satisfy the essential elements needed for a hazards analysis.

RSA has the responsibility to actively participate in this safety review process

4.0 ISS SAFETY REVIEW PROCESS

The objective of the ISS safety program is to achieve the maximum degree of safety consistent with ISS objectives and operational requirements while complying with NASA safety policy. The goal of the safety reviews in this process are to eliminate hazards through design modifications and to assure that all hazards and their causes inherent in the design have been identified and evaluated.

For hardware launched on Russian launch vehicles,
existing Russian ground and launch safety processes will be used to assure safety of launch and delivery to planned orbit. The ISS flight safety review panel will assess the safety for all phases of the ISS program after delivery to planned orbit including operations of the ISS on orbit.

For hardware launched on Space Shuttle, the ground and launch safety process is ***TBD.***

Safety reviews are conducted to verify that RS design and operations comply with the ISS safety requirements.

4.1 SAFETY ANALYSIS AND DELIVERABLES

The process for conducting a safety review was established to evaluate the results from the safety analyses. The ISS safety analyses include, as a minimum, traditional hazards analyses.

Performance of hazards analyses provides a means to systematically and objectively identify hazards and hazard causes. For assessment of the safety of RS hardware, it has been determined that a modified version of Russian ONS analysis will satisfy the intent of a traditional hazards analysis. The ONSs to be considered are those that result in unsafe conditions or consequences which may have catastrophic effects on the ISS or result in crew injury. The form to report the ONSs is a modified NASA hazard Report (HR) form. A description of data fields of the ONS/HR form is included as an attachment to this document. These ONS/HR's shall include reference to appropriate supporting attachments that will enable the safety review panel to understand and properly interpret the safety features in the RS design that are referenced in the ONS/HR. A list of ONS/HRs related to critical consequences should also be submitted to assure that they have been properly categorized. The ONS/HRs will submitted in accordance with the bilateral NASA/ RSA data exchange agreements. The ONS/HRs will be reviewed through the milestone review process and approved prior to release.

4.2 GENERAL REVIEW PROCESS FLOW

The phase safety review schedule is based upon the schedule of the major program milestone reviews. Phase safety reviews are scheduled for each stage on the Engineering Master Schedule (EMS). The ISS safety review meeting nomenclature to be used to identify the level of review is referred to as Phase I, II, and III, and corresponds to preliminary design review, critical design review, and design certification review. Three reviews are normally conducted for each stage. The depth and number of reviews is dependent on the complexity, technical maturity, and hazard potential of the equipment, and may be modified by the safety review panel in conjunction with RSA prior to the review.

Prior to all safety reviews with the ISS flight safety review panel, the RS AIT leads will review all safety assessments to assure that appropriate management accountability and to identify issues which need to be treated prior to the safety review. These issues will be reviewed by the safety panel as they are identified.

The content of each phase safety review (i.e., data requirements, content of the safety review meeting, and disposition of the HR/ONSs) is provided in section 5.0. The safety data are submitted 45 days prior to the review. Upon completion of the safety review the panel chairman will provide any major issues/items that could not be resolved within the panel to the ISS Program Manager.

NOTE: ISS payloads furnished by RSA, NASA or other IP for use in/on the RS elements or in other modules of the ISS are not reviewed by the ISS flight safety review panel as all experiments and payloads must be reviewed by a separate ISS payload safety review panel. The ISS flight safety review will only review the experiment rack to module integration.

4.3 PHASE SAFETY REVIEW MEETING

The minimum agenda for a phase safety review is defined in paragraphs 5.1.3. More than one stage may be reviewed at a single review. All actions generated at the review will be logged and

tracked by a common action tracking system for ISS. A single set of actions and minutes are generated and sent to attendees.

4.4 PHASE SAFETY REVIEW OBJECTIVES.

The phase I safety review is the first formal meeting of the safety review panel in which the safety of RS equipment and operations will be addressed. The purpose of the meeting is to present to the panel the results of the safety assessments performed by RSA and report the results at the program design reviews. The panels will focus on: assuring that all hazards/ONSs and hazards/ONS causes inherent in the design have been identified; evaluating the means employed to control the hazard/ONS; and assessing the preliminary methods identified to verify all hazard/ONS controls.

The purpose of the phase II safety review is to assess the stage / increment design and operations to assure that all appropriate hazard/ONS controls have been implemented and that the means of verifying them has been identified in detail. The safety assessment shall be completed such that (1) all system level, assembly, operational, and interface hazards/ONSs and hazard/ONS causes have been identified; (2) a means for eliminating reducing or controlling the hazard/ONS has been defined and implemented; and (3) specific verification methods have been finalized and integrated with other ISS partners.

The purpose of the phase III safety reviews is to assess the stage/design and operation and to bring ONS/HRs to closure status in preparation for program management acceptance and mission stage/increment safety certification.

By the phase III safety review, the safety analysis and safety verification activities should be complete for the stage/increment to allow safety certification.

4.5 PROGRAM HAZARD REPORT ACCEPTANCE

Approval and closure of all ONS/HRs will be made through the ISS safety review panel. Signing of the individual ONS/HRs by the ISS flight safety review panel at the conclusion of the phase safety review signifies that the ONS/HR is at the maturity of the level of the review and that the safety review panel concurs with/approves the hazard/ONS data contained therein.

4.6 SAFETY REVIEW DATA SUBMITTALS

The required safety review data shall be submitted 45 days prior to the scheduled safety review meeting. The safety data required for each phase safety review is to be submitted to the following individual:

Launch Package Russian Segment Integrated Product
Team Manager
International Space Station Program Office
Mail code OB

NASA/JSC
Houston, TX 77058

A signed original of each ONS/HR must be available to the safety review panel for signature at the time of each review. Only one copy of each deliverable must be sent to the addressee.

5.0 PHASE SAFETY REVIEW

5.1 PHASE I SAFETY REVIEW

The phase safety review is the first formal meeting between the ISS contractors, International Partner organizations, and the ISS safety review panel. The focus of the meeting is on identifying hazards/ONSs and hazard/ONS causes inherent in the preliminary design, evaluating the means of eliminating, reducing, or controlling the hazard/ONS and establishing a preliminary method for safety verification. NOTE: Where the text in section 5 refers to "hazard," the term "hazard/ONS" may be substituted.

5.1.1 PHASE I DATA REQUIREMENTS

a. Deleted

b. Flight System Design and Operations

1. Description of the system, element, or support equipment and associated operations, including baseline description of on-orbit assembly, on-orbit operations, and start-up sequence. Description of the stage configurations including conceptual description of on-orbit assembly and manned operations.

2. Summary descriptions, schematics/block diagrams of safety-critical subsystems and their operations, including schematics and block diagrams with safety features, inhibits, etc., identified.

3. Deleted

4. Flight ONSs and appropriate support data (see paragraph 5.1.2).

5. A summary listing of safety-critical services provided by other ISS segments or the Orbiter and used to control and/or monitor hazards.

5.1.2 PHASE I OFF-NOMINAL SITUATION/HAZARD REPORTS

A Phase I ONS shall be prepared for each hazard identified as a result of the safety analysis on the preliminary design and operations.

The responsible safety manager shall sign and date each ONS before submittal into the process.

Critical procedures/processes, which require special monitored verification, shall be identified in preliminary fashion. For hazards controlled by “design to minimum risk,” the following is a suggested set of support data. If the following data is provided to other NASA/RSA technical review teams, it need not be resubmitted to the safety review panel. No additional reports will be required if joint technical teams have reviewed the design and conclude that the data exchange is

sufficient. However, appropriate references to the submittal of the data and to the joint technical team which reviewed the data should be stated on the ONS/HR. The following is a list of selected subsystems that can be treated as "design to minimum risk."

a. Unpressurized Structures.
   1. Fracture Summary Report in accordance with SSP 50094.

b. Pressurized Systems.
   1. Fracture Summary Report in accordance with SSP 50094.
   2. Summary of results of verification tests/analyses.

c. Pyrotechnic Devices:
   1. Summary of results of verification test/analyses.

d. Materials:
   1. Flammability assessment.
   2. JSC Form 44, if required - update.

e. Components and elements of mechanisms in critical applications.
   1. Summary of verification results.

5.1.3 PHASE I/II/III SAFETY REVIEW MEETING AGENDA ITEMS

The agenda for each of the safety meetings shall consist of the following:

a. Title of meeting.

b. Introduction.

c. Purpose of meeting.

d. Status of pre-review activities, as applicable.

e. A design and operations overview, including a description of all safety-critical subsystems.

f. Detailed presentation of ONS/HRs (and NCRs if applicable).

g. A summary of safety-related failures (or problem reports), accidents, and significant technical issues.

h. Presentations of any proposed nonconformances.

i. Status of safety review meeting action items.

j. Panel's disposition of ONS/HRs in accordance with paragraph 5.1.4.

k. Verification tracking log status (phase III).

l. Concluding remarks.

5.1.4 OFF-NOMINAL SITUATION/HAZARD REPORT DISPOSITION

After a technical discussion is held, the panel chairs provide a disposition of the ONS/HRs. Action items are assigned by panel chairs and the list of action items signed by the panel chairmen. The disposition may take one of these forms:

a. Recommend approval as written.

b. Recommend approval with changes.

c. Recommend approval with an action to be performed by the responsible organization.

d. Recommend disapproval with an action to be performed by the responsible organization.

5.2 PHASE II SAFETY REVIEW

The purpose of the Phase II safety review is to present to the panels the updated ONS/HRs that reflect the completed design and operations of RS equipment. The HR/ONSs shall be completed such that (1) hazards/ONSs and hazard/ONS causes have been identified, (2) a means for eliminating, reducing, or controlling the hazard/ONS has been defined and implemented, and (3) specific safety verification methods (i.e., test plans, analysis, and inspection requirements, etc.) have been finalized. Interfaces to be assessed shall include those between the Russian Segment and the USOS and among the various elements and distributed systems that comprise the Russian elements of the stage configuration. Newly identified hazards/ONSs shall be documented in additional ONS/HRs.

5.2.1 PHASE II DATA REQUIREMENTS

The following data is required for the Phase II safety review:

a. DELETED

b. Flight System Design and Operations.

1. Updated Contractor End Item or Space Station Control Center (SSCC) description, mission scenario. Individual increment phase descriptions as well as assembly, and nominal operations descriptions.

2. Updated schematics and block diagrams of safety-critical subsystems and their operation with safety features and inhibits. (Defined electrical schematics must clearly indicate the required number of inhibits or controls to establish their independence).

3. Status of action items assigned during Phase I safety review.

4. Updated summary listing of critical services provided by other IP segments or the Orbiter that are used to control and/or monitor hazards.

5. Engineering drawings of safety critical subsystems

6. ONS/HRs and appropriate support data (see paragraph 5.2.2).

7. A list of safety-related failures and accidents.

8. A list of hazardous procedures (excluding ground processing).

5.2.2 PHASE II HAZARD REPORTS

The Phase II ONS/HRs shall be prepared by updating hazards/ONSs identified, providing new hazards/ONSs to reflect the completed equipment design and flight/ground operating procedures. If the equipment design is changed from Phase I to Phase II such that a Phase I ONS/HR may be deleted, a brief statement of rationale for deleting the report shall be presented in the Phase II assessment report.

All current changes to the ONS/HRs are to be identified by a bar in the right-hand margin. The submitting organization's safety manager shall sign and date each ONS/HR before submittal.

All critical procedures/processes must be addressed, including the plan for verification. For hazards controlled by “design to minimum risk,” the following is a suggested set of support data in addition to that provided for phase I. If the following data is provided to other NASA/RSA technical review teams, it need not be resubmitted to the safety review panel. No additional reports will be required if joint technical teams have reviewed the design and conclude that the data exchange is sufficient. However, appropriate references to the submittal of the data and to the joint technical team which reviewed the data should be stated on the ONS/HR. The following is a list of selected subsystems that can be treated as “design to minimum risk.”

a. Unpressurized Structures.
   1. Fracture Summary Report in accordance with SSP 50094.

2. Summary of design loads derivation leading to critical load cases.
3. Math model verification plan.

b. Pressurized Systems.
1. Fracture Summary Report in accordance with SSP 50094.
2. Summary of results of verification tests/analyses.
3. Qualification and acceptance test plan.

c. Pyrotechnic Devices:
1. Summary of results of verification test/analyses.

d. Materials:
1. Flammability assessment.
2. JSC Form 44, if required - update.
3. Fluids compatibility analysis.

e. Components and elements of mechanisms in critical applications.
1. Summary of verification results.

5.3 PHASE III SAFETY REVIEW

The purpose of the Phase III safety review is to obtain approval of the completed ONS/HRs and the remainder of the safety compliance data. The Phase III review provides the final assessment of equipment and operational compliance with SSP 41163 safety requirements.

5.3.1 PHASE III DATA REQUIREMENTS

The following data is required for the Phase III safety review:

a. DELETED

b. Flight System Design and Operation

1. TBD PYROTECHNIC DATA.

2. Final Contractor End Item or Space Station Control Center (SSCC) description, mission scenario. Individual increment phase descriptions as well as assembly, and nominal operations descriptions.

3. A final summary listing of safety-critical services provided by other IPs or the Orbiter and an explanation of services used to control and/or monitor hazards.

4. Final schematics and block diagrams of safety-critical subsystems and their operation.

5. HRs and appropriate support data (see paragraph 5.3.2).

6. Engineering drawings of safety critical subsystems when specifically requested.

7. Listing of waiver/deviation requests to safety related requirements. A signed copy of each approved waiver and deviation shall be included. (See paragraphs 6.0).

8. A summary of all safety related failures and accidents.

9. Closure of action items assigned during the Phase II safety review.

10. ISS Safety Verification Tracking Log (for flight hardware only) in accordance with Appendix C.

5.3.2 PHASE III HAZARD REPORTS

The Phase III ONS/HRs shall reflect the as-built design and operations of the equipment design and operation. Ideally, by Phase III, all safety analysis efforts are completed. The RSA shall update the Phase II ONS/HRs to (1) reflect this final equipment design and operations, and (2) document the status and results of all completed verification work. All open verifications must be listed on a safety verification tracking log. This log allows the panel chairmen to sign the ONS/HRs indicating completion of the safety analyses, but with the understanding that approval for flight will be withheld until all verification activity is complete. Approval for flight will not be withheld for open verification activities that are part of nominal on-orbit activation activities, but failure to successfully accomplish these activities on orbit may constrain subsequent on-orbit operations. Open ground and flight verifications that have been identified as a constraint against ground processing must be closed before the applicable ground operation can be performed.

Instructions for completion of Phase III ONS/HR forms are contained in Appendix B. All changes to the ONS/HRs since Phase II should be indicated by a bar in the right-hand margin. The applicable safety manager (RSA, RSC-E or KhSC) and program manager shall sign and date each ONS/HR before submittal to the panel. For hazards controlled by “design to minimum risk,” the following is a suggested set of support data in addition to that provided for phase I and II. If the following data is provided to other NASA/RSA technical review teams, it need not be resubmitted to the safety review panel. No additional reports will be required if joint technical teams have reviewed the design and conclude that the data exchange is sufficient. However, appropriate references to the submittal of the data and to the joint technical team which reviewed the data should be stated on the ONS/HR. The following is a list of selected subsystems that can be treated as “design to minimum risk.”

a. Unpressurized Structures.
   1. Fracture Summary Report in accordance with SSP 50094.

2. Summary of design loads derivation leading to critical load cases.
3. Math model verification plan.

b. Pressurized Systems.
1. Fracture Summary Report in accordance with SSP 50094.
2. Summary of results of verification tests/analyses.
3. Qualification and acceptance test plan.

c. Pyrotechnic Devices:
1. Summary of results of verification test/analyses.

d. Materials:
1. Flammability assessment.
2. JSC Form 44, if required - update.
3. Fluids compatibility analysis.

e. Components and elements of mechanisms in critical applications.
1. Summary of verification results.

5.4 POST PHASE III SAFETY ACTIVITY

When changes to the design or operation of a stage are required subsequent to the Phase III safety review but prior to launch, the ISS participants shall assess those changes for possible safety implications, including their effect on all interfaces. The assessment shall be forwarded to the panel for approval. New or revised ONS/HRs and support data shall be prepared where applicable and also submitted for review. If the safety of the stage is affected, the need for a Delta safety review is determined by the safety panel chairmen.

6.0 NONCOMPLIANCE WITH SPACE STATION REQUIREMENTS

Elements of the RS shall meet all the applicable safety requirements or obtain specific approval for each case of noncompliance. The applicable safety requirements for the RS are those requirements of SSP 41163 Russian Segment Specification paragraph 3.3.6 and other than 3.3.6 safety requirements.

When the design of RS hardware or its operations do not comply with an applicable safety requirement, a safety noncompliance report (NCR) form,(see next page), shall be submitted to obtain approval of the noncompliance condition. This form shall be signed by the RS safety manager and other RS managers as appropriate.

After submittal by RSA, the NCR shall be initially reviewed and concurred in by the SRP, Safety IPT, and Safety and Mission Assurance IPT. The concurred in NCR will be forwarded to SSIPT to obtain ISS Program Manager approval as a request for a waiver or deviation in accordance with Bilateral NASA/RSA configuration management requirements.

Note: RSA will participate in the NCR process for USOS NCR's by their participation in the ISS Safety Review Panel. In addition, NCR's that are approved by the Safety Review Panel will, in most cases, result in a waiver or deviation which will be processed in accordance with Bilateral NASA/RSA configuration management requirements.

ISS SAFETY NONCOMPLIANCE REPORT

TITLE:
Enter a brief title and tracking number for the NCR.

SYSTEM/ELEMENT:
Specify the segment, system, and /or end item that relates to the hardware to which the NCR is applicable.

APPLICABLE SAFETY REQUIREMENT:
Specify the applicable safety requirements that relate to the NCR. These are the requirements from SSP 41163

DESCRIPTION OF NONCOMPLIANCE:
Describe the specific design feature or operational capability of the hardware that does not meet the safety requirements. Clearly correlate the noncompliance condition to the safety requirement.

HAZARD OR HAZARD CAUSE:
Describe the hazard or hazard cause that relates to the noncompliance. A brief description with a reference to an ISS hazard report for additional detail is preferred.

REASON REQUIREMENT CAN NOT BE FULFILLED:
Describe the technical reasons why the requirement can not be met.

RATIONALE FOR ACCEPTANCE:
Describe the rationale for acceptance of the noncompliance condition. Rationale demonstrating safety features of the design Rationale that mitigates the safety risks such as results of testing, / analysis, or inspections shall be specified. Other relevant information that may be provided as appropriate includes time of exposure to the hazard, factors that may limit the severity of the hazard, or factors that may limit the probability of occurrence.

Cost and schedule impacts for design changes that may be necessary to correct the noncompliance condition may be included if known.

SUBMITTED BY:

ORGANIZATION:_____DATE_____

CONCURRENCE:

ISS SAFETY REVIEW PANEL_____DATE_____

APPROVAL:

ISS PROGRAM MANAGER_____DATE_____

7.0 SIMILAR EQUIPMENT

"Similar Equipment" is hardware/software which is of the same or similar design to hardware/software which has been previously certified by the flight safety review panel for its safety. Variances to the basic procedures of paragraph 5.0 have been developed for similar equipment to eliminate unnecessary duplication of effort from previously accomplished safety activity.

The user of the similar equipment(i.e., NASA or RSA) is responsible for the safety of the similar equipment and associated interfaces. To fulfill this responsibility, the user shall assess the previously approved safety data of the similar equipment for applicability to the new application and make all appropriate changes. The number and depth of the phase safety reviews to be conducted to assess similar equipment should be discussed at an early safety review meeting.

The following unique data for the similar equipment shall be submitted:

a. Identification of all similar equipment to be used and the baseline safety analyses.
b. Assessment of each similar equipment to indicate that the proposed use is the same as that analyzed and documented.
c. New or revised ONS/HRs, additional data, and identification of deleted ONS/HRs. Identification and assessment of changes in hardware/software and operations which have safety impact.
d. An assessment of the safety verification methods contained in the baseline safety analysis to determine which verification must be re-accomplished.
e. A list and description of safety noncompliances including the acceptance rationale for each.
f. Assessment of all failures and anomalies during previous usage of the similar element with corrective action taken and rationale for extended use.
i. Unique flight article data required by paragraph 5.3.1, item b.1.
j. Ionizing radiation data sheet for each source (JSC Form 44) as applicable.

APPENDIX A: Amendments to the "NASA/RSA Safety Review Process for ISS," applicable to Soyuz and Progress Vehicles

A.1.0 INTRODUCTION

This Appendix lists specific deviations to the "NASA/RSA Safety Review Process for ISS," applicable to the existing designs of the Soyuz and Progress vehicles.

A.1.1 PURPOSE

Because the Soyuz and Progress are existing vehicles, differences in the applicability of the Safety Review Process defined in the "NASA/RSA Safety Review Process for ISS," exist. These differences are detailed in this Appendix, and the appendix will become a part of "NASA/RSA Safety Review Process for ISS".

A.1.2 SCOPE

The "NASA/RSA Safety Review Process for ISS" applies to the entire RS, including the Soyuz and Progress; however, exceptions to this process are required for these vehicles.
This Appendix describes exceptions to the "NASA/RSA Safety Review Process for ISS" and applies only to the Soyuz and Progress vehicles that are existing designs and will be used as a part of the ISS.

A.2.0 SAFETY REVIEW REQUIREMENTS

A.2.1 INTERNATIONAL SPACE STATION ALPHA SAFETY REVIEWS

The following three paragraphs modifies the scope of the safety review for the Soyuz and Progress vehicles. It is agreed to modify paragraph 4.0 in the "NASA/RSA Safety Review Process for ISS" for the Soyuz and Progress only.

The objective of the ISS safety program is to achieve the maximum degree of safety consistent with ISS objectives and operational requirements. The goal of the safety reviews in this process are to eliminate hazards and to assure that all hazards and their causes inherent in the design have been identified and evaluated. For existing RS Russian Vehicles (Soyuz and Progress) NASA and RSA shall implement the Safety Review Process defined in the "NASA/RSA Safety Review Process for ISS" with the following reduced scope:

a. Hazards to the ISS caused by any ISS vehicle that is temporarily in the proximity of or docked to the ISS must be identified and controlled. This excludes hazards associated with autonomous flight of these vehicles (i.e., launch operations, orbit insertion, deorbit, and landing, etc.).

b. Hazards resulting from the inability of the vehicles to perform critical ISS functions.

A.2.2 PHASE SAFETY REVIEWS

For the Soyuz and Progress, three formal reviews have been scheduled to assess functional capabilities.

A.2.3 LEVELS OF DESCRIBING OFF-NOMINAL SITUATION/HAZARD

The level of describing the ONS/Hazard and level of subsystem analysis are determined by the ONS/Hazard category, either Catastrophic or Critical, and the complexity of the system.

A.2.4 POST PHASE III SAFETY ACTIVITY

The results of the Phase III safety review are documented by the Safety Review Panel and presented to Program Management.

A.2.4.1 CHANGES IN THE DESIGN OR OPERATION AFFECTING THE ISS

When changes to the design or operation of the vehicle are required subsequent to the Phase III safety review, the designing organization shall assess those changes for possible negative safety implications, including their effect on all interfaces. When this assessment shows hazardous effects in the scope defined in paragraph 2.1 of this appendix, the assessment shall be forwarded to the panel for approval. The data on changes to the design and operation of a vehicle affecting safety reports shall be submitted after approval of the modifications by the designing organization authorities, but no later than 180 days prior to launch of the first modified vehicle. New or revised ONS/HRs and support data shall be prepared where applicable and also submitted for review. If the safety of the vehicle is negatively affected, the need for a additional safety review is determined by the safety review panel chairmen.

A.2.4.2 CHANGES THAT DO NOT AFFECT THE ISS

When changes to the design or operation of the stage are required subsequent to the Phase III safety review, the designing organization shall assess those changes for possible safety implications, including their effect on all interfaces. When this assessment shows no hazardous effects on the ISS, submittal of additional hazard reports to the ISS Safety Review Panel are not necessary.

A.2.4.3 SAFETY REVIEW FOR THE FIRST LAUNCH

The safety review process will be held only for the first launch of the Soyuz and Progress vehicles. Subsequent launches of Soyuz and Progress vehicles will be assessed for flight readiness according to normal RSC-Energia processes. If significant modifications to the Soyuz or Progress vehicles are made after the first or subsequent launches, paragraphs 2.4.1 and 2.4.2 above will be applied.

APPENDIX B: INSTRUCTIONS FOR ISS HAZARD REPORT FORM

B.1 SCOPE

The information required to complete a ISS Hazard Report form is defined herein. The ISS Hazard Report Form (Figure B.1) and hazard report legend will be used as the standard form for all ISS equipment. ISS IPs may use an equivalent form as long as the form contains the same content fields as the ISS form.

B.2 SUPPORT DATA

Each HR should stand alone. Data required to understand the hazard, the hazard controls, and the safety verification methods should be attached to the report. Examples of such data include block diagrams, descriptions of the applicable flight/support system and its operation, a listing of the sequence of events, a list of critical procedures/processes that require special verification, and summaries of proposed tests or test results. When functional diagrams or schematics are supplied, the pertinent information shall be clearly identified (e.g., controls, inhibits, monitors, etc.).

B.3 APPROVAL

The ISS HRs will be approved in accordance with paragraph 4.5. The appropriate management personnel must sign and date the hazard report to signify agreement with the content prior to its submittal to the safety panel. During the phase safety review, the safety review panels will evaluate each HR. The panel chairman will provide a disposition for each HR.

FIGURE B.1 ISS HAZARD REPORT/OFF-NOMINAL SITUATION FORM

TEAM NAME
International Space Station Alpha
Hazard Report Number

1. HAZARD TITLE:

a. Review Level:
b. Revision Date:
c. Scope:

2. HAZARD CONDITION DESCRIPTION:

3. CAUSE SUMMARY:

1. Title:
2. Title:
3. Title:

4. PROGRAM STAGE(S):

5. INTERFACES:

6. STATUS OF OPEN WORK:

7. REMARKS:

8. SUBMITTAL CONCURRENCE:

(a) Russian Segment:

_____ _____

Safety Manager Date

_____ _____

Program Manager

9. APPROVAL:

(a) Safety Review Panel

_____ _____

Panel Chairman Date

_____ _____

Panel Chairman Date

(b) For Phase III (ONLY)

_____ _____

NASA Manager, Space Station Program Date

Hazard Report Number
Cause 1

1. HAZARD CAUSE DESCRIPTION:
SEVERITY: LIKELIHOOD: (Phase II/III)

2. CONTROL(S):

Control 1
Control 2
.
Control n

3. METHOD FOR VERIFICATION OF CONTROLS:

Verification for Control 1

Verification for Control 2

.

Verification for Control n

4. SAFETY REQUIREMENT(S):

Document: Paragraph:
Title:

5. MISSION PHASE(S):

_____ Launch Processing: (KSC launch only)
_____ Launch: (KSC launch only)
_____ Rendezvous/Docking:
_____ Deployment:
_____ Orbital Assembly & Checkout:
_____ On-Orbit Operation:
_____ On-Orbit Maintenance:
_____ Return/Decommissioning:

6. PROGRAM STAGE(S):

7. DETECTION AND WARNING METHOD(S):

8. CAUSE REMARKS:

9. REFERENCE:

10. POINT OF CONTACT:

Name: **Telephone:**

Hazard Report Number
Cause 2

1. HAZARD CAUSE DESCRIPTION:

SEVERITY: LIKELIHOOD: (Phase II/III)

2. CONTROL(S):

Control 1
Control 2
.
Control n

3. METHOD FOR VERIFICATION OF CONTROLS:

Verification for Control 1

Verification for Control 2

.

Verification for Control n

4. SAFETY REQUIREMENT(S):

Document: Paragraph:
Title:

5. MISSION PHASE(S):

_____ Launch Processing: (KSC launch only)
_____ Launch: (KSC launch only)
_____ Rendezvous/Docking:
_____ Deployment:
_____ Orbital Assembly & Checkout:
_____ On-Orbit Operation:
_____ On-Orbit Maintenance:
_____ Return/Decommissioning:

6. PROGRAM STAGE(S):

7. DETECTION AND WARNING METHOD(S):

8. CAUSE REMARKS:

9. REFERENCE:

10. POINT OF CONTACT:

Name: **Telephone:**

HAZARD REPORT LEGEND
FOR TOP LEVEL PAGES

HAZARD REPORT NUMBER: AAAA-NNNN-RR

A. Identification of Team originator:
N. Sequential number. The number must be unique to the team originator and identify entries associated with a single category of hazard.
R. Alpha character indicating the revision of the report.

1. TITLE: Enter a brief description of the hazard in terms of hazard initiator, action or consequence.

a. REVIEW LEVEL: Enter the milestone review the hazard report was written for (Phase I, Phase II, Phase III, etc.)

b. REVISION DATE: Enter the date the hazard report was entered or revised.

c. SCOPE: Describe the scope of the hazards being addressed including, as appropriate, the end item, system, subsystem, Orbital Replacement Unit (ORU), and operation.

2. HAZARD CONDITION DESCRIPTION: The hazard description should define the risk situation including the unsafe act or conditions and its effect on station, shuttle, or personnel.

3. CAUSE SUMMARY: List the titles of causes associated with this hazard.

4. PROGRAM STAGES: Using the ISS Assembly Sequence Manifest, identify the Stage(s) in which the hazard manifests itself.

5. INTERFACES: Identify the segments of the Space Station that may be associated with detection or control of the identified hazard.

6. STATUS OF OPEN WORK: Indicate the status of each open verification method. (Phase III only)

7. REMARKS: Entries here should include any information relating to the hazard but not fully covered in any other item field.

8. SUBMITTAL CONCURRENCE: The indicated managers from the applicable End-Item developer shall sign the hazard report prior to release outside of the company. Signature indicates agreement with the content at the current phase or level of program maturity and accuracy.

9. APPROVAL: The indicated Safety Review Panel Chairman shall sign the hazard report. The signature indicates agreement with the content at the current phase or level of program maturity and accuracy.

HAZARD REPORT LEGEND FOR EACH CAUSE PAGE

1. HAZARD CAUSE DESCRIPTION: Describe the types of phenomena that are of concern, i.e., the key factor to be assessed as leading to the expected outcome/consequence.

SEVERITY: This index quantifies the worst case accident or undesired event resulting from this cause. Severity levels are I (Catastrophic) and II (Critical) as referenced in RS Specification, SSP 41163 and Table B.1 below.

TABLE B.1: Table of Hazard Cause Severity

Catastrophic	I	Any condition which may cause a disabling or fatal personnel injury, or cause loss of one of the following: the orbiter, ISS or major ground facility. Loss of ISS: Loss of the ISS is to be limited to those conditions resulting from failures or damages to elements in the critical path of the ISS that render the ISS unusable for further operations, even with contingency repair or replacement of hardware, or which render the ISS in a condition which prevents further rendezvous and docking operations with ISS launch elements.
Critical	II	Any condition which may cause a non-disabling personnel injury, severe occupational illness; loss of a ISS element, on-orbit life sustaining function or emergency system; or involves damage to the orbiter or a major ground facility. For safety failure tolerance considerations, critical hazards include loss of ISS elements that are not in the critical path for station survival or damage to an element in the critical path which can be restored through contingency repair.

LIKELIHOOD: The likelihood (probability of occurrence) of this hazard cause manifesting itself after controls have been implemented. Likelihood levels are A, B, C, and D, with A being the most probable as specified in Table B.2, Likelihood of Occurrence. This field is applicable to Phase II and III only.

TABLE B.2 TABLE OF LIKELIHOOD OF OCCURRENCE OF HAZARD CAUSES

Description	Category	Mishap Definition
Probable	A	Expected to happen in the life of the program.
Infrequent	B	Could happen in the life of the program. Controls have significant limitations or uncertainties.
Remote	C	Could happen in the life of the program, but not expected. Controls have minor limitations or uncertainties.
Improbable	D	Extremely remote possibility that it will happen in the life of the program. Strong controls are in place.

2. CONTROL(S): Provide a description of all the necessary design/operational controls needed to mitigate this hazard cause, including documentation references, if applicable. The control methods identify techniques which will be or are used to control or eliminate the hazard cause and thereby satisfy the Safety Requirement. Sufficient detail shall be provided to clearly reflect controls which mitigate/control the hazard. The hazard controls shall be numbered to provide linkages with Method of Verification of Controls.

3. METHOD FOR VERIFICATION OF CONTROL(S): Identify for each control method the method of verification (procedure/processes), including document number if applicable, used to assure the effectiveness of the hazard controls. Each control verification method must link with its corresponding control, and when more than one method of verification is listed for a control, the verification methods will be listed separately (e.g., 1a, 1b, 2, 3a, 3b, 3c). Each verification method description shall include sufficient detail or explanation of the testing, inspection, or analysis which mitigates the hazard to support hazard closure or risk acceptance.
For Phase I identify the types of tests, analyses, or procedures (e.g., vibration testing, fracture analysis) to be used to verify the hazard control.
For Phase II update each method to refer to specific test (or analysis) procedures and summary of criteria to be used.
For Phase III all safety verifications should be completed. The verification method is updated to reflect any changes made after the CDR review.

4. SAFETY REQUIREMENT(S): Identify the requirements in SSP 41163 that will be addressed by this cause. Other engineering design requirements used for controls shall also be identified.

5. MISSION PHASE(S): Identify the phase of the mission in which the hazard manifests itself. An (X) indicates that the identified phase is affected by the hazard. An (O) indicates that it has been considered but is not affected.

Launch Processing covers the time period where the hardware arrives at launch site, is processed into the launch vehicle and extends to T-0 (KSC launch only).

Launch covers the time period from T-0 through orbital insertion (KSC launch only).

Rendezvous/Docking covers the time period from orbital insertion until launch vehicle is docked to the Stage.

Deployment covers the time period from launch vehicle docking through detachment of the segment or end item from the launch vehicle .

Orbital Assembly & Checkout covers the time period from detachment from the launch vehicle, mating to the pre-existing stage, checkout and launch vehicle demate.

On-Orbit Operations covers Stage operations from launch vehicle demate until the next launch vehicle mates to the on-orbit stage.

On-Orbit Maintenance covers the maintenance tasks and the tests required for verification of maintenance action completion.

Return/Decommissioning covers the time period from launch vehicle demate, from the on-orbit stage, through element removal from launch vehicle on the ground. Decommissioning covers the time period from element disassembly, form the on-orbit stage, through final disposal of the elements.

6. PROGRAM STAGES: Using the ISS Assembly Sequence Manifest, identify the Stage(s) in which the hazard manifests itself.

7. DETECTION AND WARNING METHOD(S): When applicable, describe the technique(s) used to detect the hazardous condition.

8. CAUSE REMARKS: Entries here should include any information relating to the hazard cause but not fully covered in any other item field.

9. REFERENCE: Provide numbers of reference documents used to support the hazard cause, if any reference documents are available.

10 POINT OF CONTACT: Provide the name and telephone number of the individual to be used as a point of contact for this cause.

APPENDIX C: Instructions for Developing a Safety Verification Tracking Log

(Applicable to Phase III only)

C.1 SCOPE

This appendix describes the usage of the ISS safety verification tracking log (Figure C.1), and provides instructions for its completion.

C.2 USAGE

The verification tracking log is used to formally document and status the work that is not completed at the time the final safety assessment report is prepared. (All completed verification work is documented on the appropriate hazard reports.) These verification requirements will be acted on in accordance with the process described in the Program Master Verification Plan. If all activities associated with the safety analyses (other than the open verification) are completed, the panel chairmen may sign the hazard reports indicating panel acceptance of the safety work, but with the understanding that final approval of the hazard is not complete until the HR is baselined and all applicable verification activity is completed. Items requiring on-orbit verification will be incorporated in approved assembly and checkout procedures. The procedure numbers will be referenced in the Log.

C.3 INSTRUCTIONS

Instructions for the completion of the ISS Safety Verification Tracking Log are as follows:
a. Title - the title is used to identify whether the tracking log is for a mission or a specific equipment verification.
b. Page - the specific page number followed by the total number of pages.
c. Element - the name of the element, experiment, etc.
d. Date - date completed or updated.
e. Log Number - an alphanumeric designation used to identify and track each verification item. These designations will be assigned by the project organization when the log is first submitted.
f. Hazard Report Number - the number of the hazard report containing the verification item.
g. Description Verification Number - The number from the applicable hazard report (Safety Verification Method block) for the specific verification item.
h. Description - the specific verification remaining open. Procedures will be identified by number and title.
i. Operation(s) Constrained - the specific operation(s) that this verification is a constraint against. Closure of this verification item must be accomplished before the listed, operation(s) can be performed.
j. Independent Verification Required (Yes/No) - The need (yes/no) for an independent verification of the specific item.
k. Scheduled Date - the planned date for completion of the verification.
l. Completion Date - the date this verification was completed.

m. Method of Closure/Comments/Verification Completion Notice (VCN)- the method by which this open verification has been confirmed closed, and additional information or remarks.

Figure To be provided.

Figure C.1 Safety Verification Tracking Log

APPENDIX D: ABBREVIATIONS AND ACRONYMS

AIT	Analysis and Integration Team
CR	Change Request
EMS	Engineering Master Schedule
e.g.	Example
etc.	Etceteras
HR	Hazard Report
IP	International Partner
ISS	International Space Station Alpha
JSC	Johnson Space Center
KSC	Kennedy Space Center
NASA	National Aeronautical and Space Administration
ONS	Off-Nominal Situation
RS	Russian Segment
RSA	Russian Space Agency
S&MA	Safety and Mission Assurance
SSCB	Space Station Control Board
SSCC	Space Station Control Center
SSP	Space Station Program
TBD	To Be Determined
USOS	United States On-orbit Segment

VCN Verification Completion Notice

ATTACHMENT D - NASA/RSA SAFETY POLICY AND REQUIREMENTS FOR ISS PAYLOADS

TBD

ATTACHMENT A

GROUND SAFETY REQUIREMENTS FOR THE SCIENCE POWER PLATFORM

ATTACHMENT A

Table of Contents

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to present the ground safety policy and the criteria applicable to Russian Flight hardware (referred to as "payload") and ground support equipment (GSE) design. These criteria apply to ground processing at KSC from hardware arrival to Space Shuttle liftoff and during postlanding activities. By achieving compliance to this policy and criteria, RSC-E will be able to certify to the Launch Site Safety Office that their payload and GSE are safe.

1.2 SCOPE

This document establishes the minimum NASA ground processing safety policy, criteria, and requirements for payload and their associated GSE.

1.3 APPLICABILITY

This document applies to-

A. Delete

B. Contractors in direct support of RSC-E

C. Other organizations or agencies providing direct personnel and equipment interface to payload or payload GSE support

D. Any of the above organizations that are required to support payload postlanding operations at any landing site.

1.4 RESPONSIBILITIES

The KSC Director has been assigned overall authority for safety for all Space Shuttle payload activities conducted at KSC.

A. The officials of the Launch Site Safety Office (LSSO) responsible for implementing the safety policy and criteria for the Space Shuttle Program payload activities are identified below:

1) The KSC, Director of Safety and Mission Assurance is responsible for implementing the safety policy and criteria for Space Shuttle payload activities.

2) Delete

B. The Chiefs, Biomedical and Bioenvironmental Engineering Offices, are responsible for certain activities as identified in this document. Office contacts are identified below:

1) For KSC, Biomedical Operations & Research Office (JJ).

2) Delete

1.4.1 Delegation

The Launch Site Safety Representative (LSSR) is the designated representative of the LSSO and has been delegated the following authorities:

A. Monitors LSSO selected operations and has safety approval authority for procedural deviations.

B. Gives concurrence to start these selected operations.

C. May halt any operation deemed unsafe.

1.5 CHANGES -Delete

2.0 PHASE SAFETY REVIEWS

RSC-E is responsible for the safety of their own systems and personnel. To implement this safety effort, the NASA program of phase safety reviews are implemented by SSP 30599, “Implementation Procedure for NSTS Payloads System Safety Requirements”. SSP 30599 permits the combining of the phased safety reviews based upon the complexity, technical maturity, and hazard potential of the payload. The KSC Ground Safety Review Panel Chairman, the International Space Station Program Office (code OE), and the Payload Organization (RSC-E) must agree to any combination of reviews.

3.0 DOCUMENTATION

3.1 GENERAL

Identification, submittal, and approval of the documentation required by SSP 30599 for NASA and NASA-sponsored payloads is accomplished by the phase safety review process.

3.2 PHASE SAFETY REVIEW DOCUMENTATION

The KSC Ground Safety Review Panel Chairman, the ISS Program Office, and RSC-E have agreed to the following modification to the SSP 30599 implementation process.

RSC-E will evaluate its GSE and operations and determine compliance with the ground safety requirements of this document. Verification of compliance can, in part, be performed by using the matrices provided to RSC-E by KSC Safety. Initially, five hazardous areas will be addressed in the RSC-E ground safety data package for the Science Power Platform. These are 1) Lifting & Handling, 2) Pressurized Systems (greater than 30 psig), 3)Electrical (power supply for non-commercial equipment), 4) Hazardous Materials (toxic, corrosive chemicals), and 5) Radiation. Hazard Reports will be produced when compliance to requirements can not be verified. If a Hazard Report is required, the format for the Hazard Report will be in accordance with SSP 50146.

There is to be three formal submittals of the RSC-E developed ground safety data package. These three submittals will support the three formal Ground Safety Review Panel meetings.

The ground safety data package may reference other RSC-E documents as long as the referenced documents are provided to KSC Safety.

Based upon the above modifications, RSC-E shall provide the Safety Review panel the following data to support the two formal meetings:

A. Block diagrams, schematics, and descriptions of safety-critical subsystems. This includes tables of design and operating parameters for such items as lifting equipment, pressure systems, and batteries.

B. Launch site processing plan including timelines for handling, storage, assembly, servicing, and checkout operations.

C. List of Technical Operating Procedures (TOP's), a synopsis of each procedure, and their preliminary classifications; i.e., hazardous or nonhazardous.

D. Documentation certifying compliance with ionizing and nonionizing radiation control requirements.

E. Hazard reports addressing both design and operations, if compliance can not be verified.

F. Failure/accident summary reports.

G. Copies of all noncompliance reports.

H. Delete.

I. A list of all hazardous materials and physical agents. Material Safety Data Sheets (MSDS's) (CFR 1910.1200) or equivalent shall be provided to the LSSO for all material and agents brought to the KSC by the payload organization.

J. A list of all plastic films, quantity, and location of use.

K. List of the payload T-O Umbilical functions.

L. Critical software commands must be identified and managed. These critical software commands include commands which, if executed or executed out of sequence, would create a hazardous condition or would remove a safety inhibit.

3.3 LAUNCH SITE DOCUMENTATION

3.3.1 Payload Organization Launch Site Safety Plan

RSC-E shall provide a Launch Site Safety Plan which demonstrates the means by which RSC-E manages and interfaces safety within its organization and how it applies the launch site safety requirements. All plans shall be tailored to the complexity of the payload element and be provided to the LSSO for review and approval at least 30 days prior to first hardware delivery to the launch site.

3.3.2 Technical Operating Procedures (TOP's)

In order to be accomplished in a safe and orderly manner, payload ground operations must be conducted using detailed step-by-step instructions in TOP's. All TOP's designated hazardous by the LSSO or by RSC-E shall be written in English and are required to be approved by the LSSO and published and "on the shelf" 10 days prior to use (5 days prior to use for revisions). Draft or preliminary procedures should be submitted to the LSSO when available. Where procedures are used to control hazards identified in the hazard reports, a listing of those procedures and the applicable step numbers which control the hazard shall be identified in the Phase III data package as applicable. Appendix C contains guidelines for the preparation of TOPs.

3.3.3 Payload Safety Noncompliance Reports

RSC-E must obtain an approved variance (waiver) for each case of inability to comply with a specific safety requirement.

3.3.3.1 Waivers - Each waiver request shall be limited to a specific subsystem or component in a specific application. The following information is required for the waiver request:

A. The payload name and the model of the payload or support equipment as applicable.

B. The specific component and the subsystem in which the component functions shall be identified.

C. The specific requirement (one per waiver) and document and paragraph number against which the waiver is being sought.

D. The hazard created by noncompliance to this requirement and a cross-reference to the related hazard report. (If applicable).

E. Reason for noncompliance to this requirement.

F. Give rationale for acceptance of this waiver, including any required support data and drawings, and list possible methods and techniques used in mitigating the hazards.

G. This waiver request must be signed by the program manager of the payload organization.

3.4 DOCUMENTATION CHANGES

Changes or modifications which affect any approved phase safety review or launch site documentation must be provided to the LSSO for review and reapproval.

4.0 SAFETY REQUIREMENTS

Payload organizations shall comply with the following policies, practices, and regulations.

4.1 OPERATIONAL CONSIDERATIONS

4.1.1 Failure Tolerance - Delete

4.1.2 Personnel Policies

RSC-E shall provide a description of their Training/Certification Program to the LSSO as part of the payload organization Launch Site Safety Plan. This program shall specify the personnel training required and the certification procedures employed to establish acceptable skill levels for all personnel involved in the ground processing of SSP payloads and GSE. Ground processing shall be performed only by persons certified in the discipline required for that process.

4.1.2.1 Training - Safety and health inputs to training programs shall be tailored to the task categories involved and included in lesson plans and examinations. Safety training of operating personnel is the responsibility of the RSC-E. RSC-E shall meet the applicable facility and operating site requirements.

4.1.2.2 Certification - RSC-E shall provide a list to the LSSO prior to commencement of hazardous operations of all personnel authorized to participate in hazardous operations certifying each individual's training and qualification by system to perform a specific hazardous operation.

4.1.2.3 Physical Examination - Personnel performing selected hazardous operations are required to have up-to-date physical examinations which meet the requirements of the cognizant medical office. The requirements for physicals for selected hazardous operations are as follows:

A. Lifting Operations. Personnel operating overhead cranes require a crane operator (Category 1 or 2) physical examination.

B. Noise. Personnel that work in or around flight or ground support equipment that produce a continual noise level above 85 dB(A) require a hearing conservation physical examination.

C. Heavy Equipment. Personnel that operate mobile equipment that weighs more than 2000 pounds require a heavy equipment operator physical examination. Examples of this equipment includes forklifts and man lifts.

D. Working at Heights. Personnel working at heights more than four feet above the ground will wear fall protection equipment and will require a high crew physical examination.

E. Ammonia servicing. Personnel that work within 10 feet of ammonia servicing equipment while the equipment is in operation or during open ammonia system operation require a respirator physical examination. Examples of open ammonia system operation are component replacement, during connections/disconnections and tasks to repair leaks such as tightening connections.

4.1.2.4 Safety Enforcement - Delete

4.1.3 Hazardous Operations

A. A ground processing activity is classified as hazardous based on the following considerations:

1) Energy is involved and loss of control could result in injury to personnel or damage to equipment.

2) A significant change from ambient condition will occur; e.g., increase or decrease of oxygen content, pressure, or temperature.

3) Presence of hazardous materials or physical agents which presents potential exposure to personnel.

B. TOPs are required for any activity, either by itself or in combination with another, which can result in injury to personnel or damage to property involving, but not limited to, the following:

1) Delete.

2) Delete.

3) Delete.

4) Cryogenics.

5) Lifting/Handling.

6) Radiation.

7) Toxics/Combustibles/Corrosives.

8) Pressure.

9) Electrical.

C. All hazardous or LSSO designated procedures require notification of the LSSR at least 24 hours prior to their performance.

D. Concurrent hazardous operations within the same hazard control area are prohibited.

E. Concurrent operations within a hazard control area require LSSR or LSSO approval.

4.1.4 Safety Inspection

LSSR and RSC-E shall perform joint systematic safety inspections of the facility, working environment, related GSE, and any work in progress which could cause accidental injury to personnel or damage to hardware. These safety inspections shall be performed on payload processing facilities at the following minimum times:

A. Prior to payload/GSE installation in the facility.

B. Immediately after installation of payload/GSE.

C. Immediately before the start of LSSO selected hazardous operations.

D. After any facility or equipment modification which may affect hazard potential.

4.1.5 Safety Equipment

RSC-E shall ensure that personnel protection is provided when engineering controls alone are not adequate to provide sufficient employee protection. All personal protective equipment shall be approved by the LSSO and Biomedical Office.

4.1.6 Tools

4.1.6.1 Temporary Restraints - Temporary restraints, such as tethers, shall be used for individual tools to prevent misplacement or loss in critical areas when working above personnel or sensitive equipment.

4.1.6.2 Control of Tools - All tools and related equipment used in the proximity of flight articles shall be controlled to minimize the potential for foreign object damage.

4.1.7 Photography

Camera permits are required for all photographic operations in controlled areas. The LSSO requires that the use of photographic lighting equipment (e.g., flashbulbs, strobe lights, and photofloods) be restricted within 100 feet of the Orbiter/payload whenever they are loaded with any propellant (not ammonia), within 100 feet of a propellant storage tank, and within 10 feet of exposed solid propellants. These control areas do not apply to the SPP while located in the Space Station Processing Facility. Photo equipment used above a payload must be tethered and the light sources shielded to prevent debris from falling onto the payload. The payload organization shall obtain LSSO approval to use photographic equipment in these and other hazardous atmosphere locations. Refer to paragraph 4.4.2.3 for the control area for ammonia servicing.

4.2 PERSONNEL SAFETY

4.2.1 Human Factors

RSC-E shall consider human factors in the design of GSE and the payload.

4.2.1.1 Human Error - All equipment controls shall be labeled.

4.2.1.2 Noise - Delete

4.2.1.3 Hazardous Materials - RSC-E shall assure through design/procedural controls that payload/ground processing GSE and operations will not expose KSC or RSC-E personnel to hazardous materials in excess of the limits specified by the cognizant Biomedical Office.

4.2.1.4 Physical -

A. Accidental contact with sharp surfaces or protrusions shall be prevented by the use of ductile materials, energy absorbing devices, shields, rounded corners, and flush-mounted features. Sharp surfaces or protrusions include edges, crevices, points, burrs, wire ends, screw heads, corners, brackets, rivets, braided cable, cable swages, cable strands, clamps, pins, latches, lap joints, bolt ends, lock nuts, etc., which if contacted, could injure operating personnel.

B. Hazards shall not be created by the inaccessibility of flight or ground hardware. Physical access for safety critical operations or maintenance functions shall be provided. Protrusions which create a hazard such as hoses, wave guides, cables,

brackets, etc., which cannot be eliminated by design, shall be made to be removable during service or maintenance functions.

C. Moving parts such as fans, belt drives, turbine wheels, and similar components that could cause personnel injury or equipment damage due to inadvertent contact or entrapment of floating objects shall be provided with guards or other protective devices.

D. Delete

E. Delete

F. All GSE designs should include a center-of-gravity analysis to ensure that the GSE/flight hardware does not tip, fall, slide, or allow for any type of sudden load shift.

4.2.1.5 Temperature - RSC-E shall protect personnel from equipment which can generate high or low temperatures greater than 45^{o}C (113^{o}F) or less than 0^{o}C (32^{o}F). This equipment shall be shielded, insulated, isolated, and/or oriented away from personnel and labeled to warn them of the danger.

4.2.1.6 Radiation - The payload organization shall advise and protect personnel from equipment which radiates ionizing or non-ionizing radiation.

4.3 PAYLOADS AND GROUND SUPPORT EQUIPMENT (GSE)

4.3.1 Biomedical Subsystems - Delete

4.3.2 Electrical

All electrical equipment shall meet the requirements of this section to preclude hazardous conditions.

4.3.2.1 Electrical Requirements -

A. Electrical connectors shall be designed to make it physically impossible to inadvertently reverse a connection or mate the wrong connectors if a hazardous condition can be created. These connectors for energized circuits must also be of "scoop-proof" design so that a partial inadvertent mismate will not provide pin-to-pin contact.

B. Electrical equipment shall not cause ignition of adjacent materials. The requirements for explosion/ hazardproofing at the launch site are identified in Paragraphs 4.4.2.3 and 4.4.2.4.

C. Malfunction of the payload or GSE circuitry shall not induce overload into the Orbiter, GSE, or facility electrical systems.

D. Electrical equipment shall be designed to provide personnel protection from accidental contact with alternating current (AC) voltages in excess of 30 volts root mean square (rms) or 50 volts direct current (DC) or any lower voltage that could cause injury.

E. Construction of the payload and electrical GSE shall assure that all conductive external parts and surfaces are at ground potential at all times.

F. Cables extending across work areas shall be protected against damage from personnel activity or equipment use.

G. Switches/controls which can create hazardous conditions if inadvertently operated shall be guarded, shielded, or otherwise protected against inadvertent switching.

H. Electrical fuse and switch boxes shall be labeled on the outside or inside cover to show the voltage present, rated fuse capacity, and equipment that the circuit controls.

I. Non-bypassable interlocks shall be used to prevent possible shock whenever a voltage in excess of 500 volts is exposed upon opening an access door, cover, or plate.

J. All GSE shall meet the requirements of the Russian Industry Standards

K. Dead-end wires shall be completely insulated.

L. Three-phase power sequencing must be verified in each KSC processing facility prior to connection.

M. Battery charging/conditioning shall be accomplished in the battery laboratories unless approval is granted from the LSSO to accomplish the charging elsewhere. Battery charging equipment shall be continuously monitored by personnel. Charging/conditioning performed in hazardous locations shall comply with paragraphs 4.4.2.4.1 and 4.4.2.4.2. The payload organization should consider incorporating voltage and current limiters, fuses, diodes, and temperature and pressure monitors in the charging/conditioning electrical GSE.

N. The payload should be assessed to determine if the loss of power during any phase of ground processing is a hazard to personnel or equipment. If so, an alternate or backup power source may be required.

4.3.2.2 Grounding, Bonding, and Shielding -

A. The design, construction, and installation of equipment shall be such that all external parts, surfaces, and shields are at ground potential at all times.

B. Grounding and bonding schemes shall ensure proper interfacing between equipment and facility.

C. Power cords on GSE shall provide a non-current carrying ground conductor unless the unit is double insulated.

D. Grounding/bonding connections of GSE shall be designed to minimize the possibility of inadvertent disconnection.

1) Solder shall not be used for external connections.

2) Threaded fasteners shall use lock washers.

E. GSE external bonding straps and jumpers shall be capable of carrying the maximum expected fault current.

F. Delete.

4.3.2.3 Electrical Maintenance Operations - Maintenance operations on energized electrical circuits are normally prohibited. Maintenance operations shall be performed in accordance with accepted industrial practice. In addition, the following shall be included:

A. Any accessible capacitor circuitry which presents a hazard to personnel shall be discharged prior to performing maintenance.

B. Protective equipment such as nonconducting fuse pullers, rubber gloves, nonconductive matting, etc., shall be used when working on energized circuits which could cause personal injury.

C. Procedures for tagging and lockout of control switches and circuit breakers shall be provided.

D. All grounds shall be verified to be intact.

E. Worn, abraded, or defective insulating material shall be repaired or replaced.

F. Only fuses of proper voltage and current ratings shall be used in circuits. No other material will be used in place of a fuse.

4.3.2.4 Electrical Control of Hazardous Functions - Where electrical GSE is used to control a potentially hazardous function, it shall be designed to be failure tolerant. Acceptable failure tolerance will be determined by the LSSO during the safety review process. Where feasible, failure tolerance shall be implemented through design control rather than procedural control. Design control can be implemented by eliminating the potential hazard (e.g., the current-limiting features in EED bridgewire checkers), providing a fail safe design (e.g., current-limiting fuses) or requiring multiple component failures and/or operator actions prior to a hazardous event occurring.

4.3.2.5 Energized Electrical Equipment -

A. Energized equipment will be manned or connected to the manned facility emergency power shut-off system. The electrical equipment will be powered down during non-working hours. All electrical equipment located outside of a hazardous processing area will be inhibited from supplying power to electrical equipment located within the hazardous processing area during non-working hours.

B. Electrical equipment that must remain energized for hazardous operations (i.e., maintaining spacecraft thruster solenoid valves in an opened or closed state) shall be equipped with an uninterrupted power source such as a battery backup.

4.3.2.6 Battery Charging - Battery charging operations should occur in an approved charging facility. Battery charging requirements for batteries that cannot be removed from flight hardware will be assessed on a case-by-case basis.

4.3.3 Pressure/Vacuum Systems

Pressurized systems contain fluids above atmospheric pressure. Vacuum systems contain fluids below atmospheric pressure. Pressure system elements include tanks, accumulators, lines (e.g., piping, tubes, and hoses), fittings, gauges, filters, valves, regulators, and other components.

4.3.3.1 Pressure System Requirements -

4.3.3.1.1 Delete

4.3.3.1.2 The following requirements shall be met by both flight and ground pressure systems:

A. To preclude personnel injury, provisions shall be made for accomplishing remotely controlled pressurization of the flight pressure system. Exception to this requirement is when the conditions of Paragraph 4.3.3.2.1 do not apply or when the payload operator provides a certification statement of system pressure testing to the LSSO in accordance with Paragraph 4.3.3.2.2. Normally, remote pressurization of GSE is not required.

B. Regulator failure shall not create a hazard to personnel or equipment during ground processing.

C. All items, including gauges, which come in contact with the service fluid shall be of compatible material.

D. Delete

4.3.3.1.3 GSE containing pressure systems shall meet the following requirements:

A. Delete

B. GSE pressure systems hardware other than pressure vessels shall be marked as follows:

1) Pressure system lines (where the function of the line is not immediately apparent) shall be labeled with the maximum operating pressure (MOP), fluid content, and direction of flow.

2) Delete

3) Other system components shall be labeled with their manufacturer's name and part number, serial number (if applicable), pressure rating, and direction of flow.

C. Pressure systems components shall have a design burst pressure (D.B.) of at least 4 times the MOP of the system. Components shall be pressure tested at 1.5 times MOP unless otherwise approved by the LSSO.

D. Regulators shall be selected so that their working pressure falls within the center 50% of their total pressure range if susceptible to inaccuracies or creep.

E. Flight and GSE components downstream of a GSE regulator shall be designed to safely operate under full upstream pressure. Open-ended purge systems may be protected by flow restriction orifice devices.

F. If the requirements of Paragraph E (above) cannot be met, relief devices shall be provided as follows:

1) Downstream of last GSE regulator prior to flight hardware interface.

2) GSE pressure vessels.

3) Downstream of regulators where upstream pressure exceeds downstream design operating pressure.

4) Container purge systems using metal tubing or flex hose.

5) Container purge systems using plastic tubing when the failure of the tube provides sufficient margin of safety to the downstream equipment.

6) All relief devices shall be relief valves when pressure exceeds 149 psig.

G. Set pressure: Pressure relief valves shall be set to relieve at a pressure not to exceed the MAWP of the vessel or the design pressure of the system involved (including flight systems), and the set limits shall be specified in the Operation and Maintenance Requirements Document (OMRSD) or other operating and maintenance documents. The setting of relief valves shall be set to open at a pressure not to exceed 110% of the system MOP.

H. For piping/tubing systems, the required relieving capacity shall be equal to or greater than the maximum flow capability of the upstream regulator or pressure source and shall prevent systems from exceeding their MAWP.

I. Relief devices shall be located so that other components such as shut-off valves cannot render them inoperative. Relief devices and their associated discharge plumbing shall be adequately supported such that their discharge impulse will not cause structural failure.

J. Pressure relief for toxic liquids and/or vapors shall be designed and located so that gases and liquids or vapors will not enter any inhabited areas. Pressure relief for inert gases shall not be discharged into a confined, occupied area where oxygen content could be lowered below acceptable limits. Pressure reliefs for high pressure gases and liquids shall be located such that the discharge will not endanger personnel.

K. Pressure systems shall be equipped with gauges as follows:

1) Downstream of each regulator.

2) On any storage system.

3) On any section of the system where pressure trapped by isolation valves creates a hazard.

L. All pressure gauges shall comply with the following requirements:

1) Gauges shall be selected so that the operating pressure is not more than 75% of the highest graduation.

2) Pressure gauges shall be of one piece, solid front construction and shall have an optically clear shatterproof window. Gauges should be designed for bolted flush front panel mounting.

3) Gauges shall have blowout backs to allow unrestricted venting in the event the gauge sensing element ruptures.

4) All items which come in contact with the service fluid shall be constructed of compatible material.

5) A due date calibration sticker shall be affixed to gauges used for safety-critical monitoring.

6) Gauges shall be equipped with a bourdon-tube bleeder or equivalent device to facilitate cleaning.

M. All GSE using flex hoses with pressures above 150 psig shall be designed to provide attachments for flex hose restraining devices.

N. Isolation valves shall be designed to permit flow or isolation in both directions at the valve's MAWP.

O. Pressure systems shall be designed so that pressure cannot be trapped in any part of the system without bleed capability.

P. Manually operated valves and regulators shall be selected so that over-torquing the valve stem or regulator adjustment cannot damage soft seats to the extent that seat failure occurs. Designs using uncontained seats are unacceptable.

Q. Pressure system elements which are not intended to be reversible shall be designed or marked such that they will not be connected in a reverse mode.

R. Lines, relief devices, and other pressure system elements shall be routed and/or located to provide for the protection of other systems and personnel.

S. Control stations shall have adequate instrumentation to allow personnel to monitor pressure levels and confirm that initiated actions have occurred.

T. Control stations shall be designed so that the operator does not have to leave the station to monitor hazard levels.

U. Systems shall have shut-off valves located as close to the supply vessel as practicable.

V. Check valves shall be provided where backflow of fluids would create a hazard.

4.3.3.1.4 Delete

4.3.3.1.5 Flexible Hoses - Flexible hoses consist of an inner liner tube of teflon or other material (compatible with the service fluid) reinforced by layers of wire and/or fabric braid or wrap. Use of flex hoses should be minimized. Requirements for flexible hoses are as follows:

A. Delete

B. Flexible hoses shall be installed so that they do not carry any external mechanical load and are not subjected to tension, torsion, or overheating.

C. All flexible hoses shall have a design burst pressure equal to or greater than 4 times the MAWP.

D. All flexible hoses pressurized to 150.0 psig (10.34 bars) or greater shall be contained or restrained. Hose restraint shall be accomplished using a chain or cable securely anchored to a substantial object and to the hose assembly at the following points: 1) Hose end connector; 2) each union or hose splice; and 3) intervals not to exceed 6 feet (1.83 meters). Hose restraint devices and attachment methods shall be approved by the LSSO.

E. The payload organization shall establish criteria and obtain LSSO approval for periods of inspection and retest. Time in service, type of service, and pressure are factors for determining need of pressure test. LSSO approval shall be obtained prior to performing pressure testing at the launch site.

F. All flexible hoses shall be inspected prior to use. Flexible hoses which show signs of physical damage shall be replaced.

G. Flexible hose assemblies shall be pressure tested to 1.5 times their MAWP.

H. GSE flexible hoses shall be identified and marked. Each flexible hose assembly shall have a metal tag(s) attached which bears the following information:

1) Date of proof test (month and year).

2) Dedicated fluid service; e.g., fuels, oxidizers, hydraulics.

3) MAWP.

4) Identifier (manufacturer/part number).

I. After each pressure test recertification, the old tag(s) will be removed and new ones attached.

4.3.3.1.6 GSE Hydraulic Systems - Delete

4.3.3.2 Pressure System Operations - Pressure system operations shall comply with the following:

4.3.3.2.1 The following flight and ground support system pressurization operations shall be accomplished remotely (e.g., locate control station behind a blast shield) unless otherwise approved by the LSSO:

A. The first time a flight system is pressurized above 25% of the design burst at the launch site. This pressure is designated the "initial pressurization level."

B. Any flight system pressurization above the initial pressurization level; this latter pressurization becomes the new initial pressurization level.

C. Any pressurization above MOP/MAWP.

D. Any pressurization of a system that has suspect integrity.

4.3.3.2.2 Remote pressurization may not be required if RSC-E provides documentation which certifies the following:

A. The assembled system has been pressure tested at a pressure which is at least 1.5 times the system MOP unless otherwise approved by the LSSO.

B. The assembled system has been functionally leak tested at a pressure equal to or greater than MOP. The system log book shall track system handling/movement in addition to pressurizations, maintenance, etc.

C. System configuration has not been modified or repaired subsequent to the above testing. Unwelded relief or sensing devices may be replaced after system pressure testing but not after system leak testing, in accordance with Paragraph 4.4.3.2.9.

D. A procedure has been written which requires inspection of the system upon arrival at the launch site for damage sustained during transportation and handling. The procedure shall also require a check of the pressure system log book to verify that activity after the pressure test and leak test did not affect the integrity of the system. Provide procedure name and number, step numbers and test which require the inspection, and any additional inspection criteria.

4.3.3.2.3 Personnel will be allowed in the immediate proximity of pressure systems only when pressure does not exceed the system MOP.

4.3.3.2.4 System integrity shall not be broken on pressurized systems without first depressurizing to 10 psig or less. Depressurization shall be accomplished only using components designed for the purpose. Backing off of line fittings, when pressures exceed 10 psig, to depressurize is permitted if the trapped volume does not exceed 1.5 cubic inches. Tightening of line fittings under pressure is also prohibited.

4.3.3.2.5 Systems shall not be pressurized or depressurized at rates which present unsafe situations, such as heat rise to autoignition. These rates shall be identified in the applicable operating procedure.

4.3.3.2.6 Pressure system bolts and fittings shall not be torqued while the component is under pressure.

4.3.3.2.7 Relief valves shall be inspected, reset, tested, and labeled annually.

4.3.3.2.8 Pressure gauges shall be inspected and calibrated annually and a due date label applied where used in safety critical systems.

4.3.3.2.9 All nonhydraulic pressure systems are to be leak tested with an inert medium at MOP at the launch site prior to using propellants or hazardous gases. Any time a component is modified, repaired, or replaced, it shall be pressure tested to 1.5 times MOP at the component level. The reassembled system shall again be leak tested at MOP using an inert medium.

4.3.3.3 Vacuum Systems and Requirements - Negative pressure protection shall be provided for systems not designed to withstand pressure below 1 atmosphere. This can be accomplished by the use of check valves or ambient automatic pressure valves.

4.3.4 Radiation

Sources of ionizing and nonionizing radiation must be adequately controlled during all phases of ground, launch, and postlaunch operations to assure the protection of personnel, facilities, and equipment, and the compliance with applicable federal, state, and NASA regulations and requirements. Such sources include radioactive materials, radiation-producing equipment (e.g., x-ray devices, particle accelerators, radio frequency/microwave emitters, etc.), lasers, and optical emitters (e.g., ultraviolet, infrared, and high intensity visible light sources). Specific requirements are provided in detail in the referenced applicable control documents and must be coordinated through the LSSO.

4.3.4.1 Radiological Health -

A. Applicable radiological health program documents governing uses of ionizing and nonionizing radiation sources at KSC include:

KHB 1860.1A, "KSC Ionizing Radiation Protection Program"

KHB 1860.2, "KSC Non-Ionizing Radiation Protection Program"

The above-mentioned documents contain procedural/administrative requirements for radiation source approvals and usage.

B. All uses of radiation sources require review and evaluation for approval by the appropriate launch site Radiation Protection Officer (RPO). Radioactive materials procurement, use, storage, and transportation at launch/landing sites are subject to specific requirements. Such activities must be coordinated with the launch/landing site RPO at least 60 days in advance of arrival to the launch site to assure compliance with applicable regulations. Identification of the launch/landing site RPO will be provided through the LSSO.

4.3.4.2 Radiation Safety - Additional radiation hazard controls required by the LSSO are provided below:

A. Radiation sources associated with payloads must be compatible with and have no adverse safety effects on ordnance items, propellants, high pressure systems, critical structure components, or systems of any other payload, the Space Shuttle, or its crew.

B. Delete

C. Radiation source shields, interlocks, fail-safe systems, and limit switches shall be checked for proper operation.

D. All radiating systems shall be designed, constructed, and operated to prevent exposure of personnel, facilities, and equipment to extreme temperatures, high voltages, toxic fumes and gases, and unnecessary radiant energy.

4.3.4.3 Optical Systems - The potential hazards which must be considered in the design, handling, and operation of optical equipment and associated energy sources may be grouped into five categories as follows:

A. Hazardous optical radiation to include ultraviolet, infrared, and visible radiation.

B. Temperature extremes.

C. Shatterable materials.

D. Contamination from gases and cryogenics.

E. High voltage and x-rays.

4.3.4.3.1 General Optical Requirements - The following requirements shall apply to both flight and ground optical systems:

A. Optical instruments shall be designed such that harmful light intensities and wavelengths cannot be viewed by operating personnel.

B. Quartz windows, apertures, or beam stops and enclosures shall be used for hazardous wavelengths and intensities unless other suitable protective measures are taken to protect personnel from ultraviolet and/or infrared burns or x-ray radiation.

C. Light intensities and spectral wavelengths at the eye piece of direct-viewing optical systems shall be limited to levels below the maximum permissible exposure (MPE).

4.3.4.3.2 Laser System Requirements - In addition to the referenced documents, the following requirements shall apply to both flight and ground hazardous laser systems:

A. Limit stops, interlocks, and shields shall be provided to ensure that a laser beam cannot be misdirected.

B. Laser power shall be locked out during all operations except laser testing.

C. Positive locking features shall be provided to preclude focus and/or directional changes due to vibrations or inadvertent contact by operating personnel.

D. Laser systems shall be designed so that all external components are at ground potential at all times.

E. Materials used must be able to withstand the stresses caused by repetitive laser pulsing for the duration of checkout and mission performance.

F. Laser systems shall incorporate a shutter system, beam stop, or attenuator capable of preventing output emissions in excess of the appropriate MPE level when the laser or laser system is on standby.

G. Provisions shall be made to measure power output and perform boresighting with the beam totally enclosed and without unnecessary exposure to operating personnel.

H. Laser target materials shall be nonreflective and fire resistant and shall not emit toxic contaminants.

I. Laser installations shall incorporate adequate means to prevent the accumulation of hazardous cooling fluids and their by-products.

J. Whenever toxic chemicals and/or cryogenic materials are utilized with laser systems, shut-off valves shall be provided to control leakage in the event of a line rupture.

4.3.4.3.3 Laser Operations - Laser operations shall include but not be limited to the following requirements:

A. Alignment of target, optics, filters, etc., shall be accomplished utilizing low-powered visible lasers.

B. Active beam or target viewing shall be done only by closed circuit television or an optical comparator with an appropriate filter.

C. Laser beams shall not be directed toward flammable or explosive materials.

D. Activated lasers shall not be left unattended.

E. Personnel whose occupation or assignment may involve exposure to laser radiation shall use laser safety goggles approved by the Biomedical Office. These goggles shall protect for the specific wavelength of the laser and be of optical density adequate for the energy levels involved.

4.3.5 Ordnance - Delete

4.3.6 Mechanical, Electromechanical Devices

Mechanical or electromechanical devices that are used for such purposes as structure deployment or actuating release mechanisms must be evaluated to establish whether in the event of inadvertent activation damage to equipment or injury to personnel could occur. These devices shall be identified in the operational hazards analysis with the requirement for caution and warning notations incorporated in the TOP's (See 3.3.2).

4.3.7 Ammonia

The following requirements apply to the servicing of the SPP in the Space Station Processing Facility (SPPF) with ammonia. This operation is assumed to be performed using the KSC provided ammonia servicing cart. If RSC-E decides to use their own cart for the ammonia servicing operations, the design of the cart shall comply with the requirements of paragraph 4.3.3 above. Materials selected for use in ammonia systems shall be compatible with ammonia.

4.3.7.1 Ammonia Servicing Requirements -

A. Ammonia servicing operations shall be performed only in areas and at times approved by the NASA Safety office. Personnel shall be limited to those directly involved in the ammonia servicing operation. Ammonia servicing shall only occur during 2nd and 3rd shifts on weekdays. 1st shift operations may be conducted on weekends.

B. RSC-E shall describe their plans for controlling an ammonia leak throughout the ground processing at KSC. Procedures shall contain emergency instructions to handle leaks and spills.

C. The SPP and the ammonia servicing equipment shall be grounded during ammonia servicing operations.

D. Prior to opening the SPP ammonia system, the system shall be drained and flushed or purged to safe concentration levels.

E. A leak test at maximum operating pressure with an inert gas shall be performed initially prior to servicing and after any modification or repair to the SPP ammonia system. Refer to paragraph 4.3.3.2.9 above for more details. The proper operation of quick disconnects shall be demonstrated during the leak tests.

F. The disposal of ammonia (liquid) shall be coordinated with the NASA Safety office.

G. Venting of ammonia shall only be performed with approval from the NASA Safety Office. Ammonia shall be captured or vented to the atmosphere outside the SSPF.

H. During ammonia servicing, a 10 foot control area shall be established around the ammonia fill lines, equipment, and flight hardware. Personnel protective equipment is required to be worn by all personnel within the control area. Protective equipment includes a rubber apron, rubber elbow length gauntlet style gloves, face shield, and a supplied air respirator for line connects and disconnects.

4.3.8 Cryogenics

4.3.8.1 Cryogenic Systems Requirements -

A. Source flow shall have throttling capability

B. Delete.

C. GSE cryogenic valves with extended stems shall be installed with the actuator approximately vertical above the valve.

D. Joints in piping systems shall be of either butt-welded, flanged, bayonet, or hub type.

E. Cryogenic systems shall provide for thermal expansion and contraction without imposing excessive loads on the system. Bellows, reactive thrust bellows, or other suitable load relieving flexible joints may be used.

F. GSE vacuum-jacketed systems shall be capable of having the vacuum verified.

G. Cryogenic systems shall be designed so that anywhere a cryogen can be trapped between any valves in the system, automatic relief is incorporated to preclude excess pressure caused by conversion from liquid to gaseous state causing a rupture.

H. Cryogenic systems shall be insulated with an oxygen compatible material or be vacuum-jacketed to preclude liquefaction of air.

4.3.8.2 Cryogenic Systems Operations -

A. Cryogenic systems must be pressure tested with an inert medium at cryogenic temperature followed by a proof test at ambient temperature (no less than 60 ^{o}F). Pressure testing shall be 1.5 times MOP except where lesser factors (no less than 1.1 times MOP) are warranted to avoid adverse effects (e.g., plastic deformation or strain hardening) on the system.

B. Cryogenic systems, including vacuum-jacketed pipe, shall be cold-shock tested with an appropriate cryogenic inert medium (at MOP or greater) prior to introducing any hazardous commodity into the system. Cold-shock leak testing can be accomplished at proof pressure to satisfy the cryogenic proof pressure requirements in paragraph A above.

C. Delete.

D. All personnel involved in cryogenic propellant transfer operations, repairs, or adjustments to the system must wear LSSO and Biomedical Office approved personal protective equipment.

E. Delete.

4.3.9 GSE Materials

A. A list of materials shall be maintained for each piece of GSE which interfaces with hazardous fluids. Hazardous fluids include, but are not limited to, gaseous oxygen, liquid oxygen, gaseous hydrogen, liquid hydrogen, Freon-21, ammonia and potassium hydroxide. This list will be of sufficient detail to permit an evaluation of the compatibility of the GSE design with the environment in which it is to be used.

B. Mercury in liquid or vapor form shall not be used in GSE if a substitute of equivalent performance exists or an appropriate alternate design or method can be used. Mercury shall not be used in any applications where contamination of flight hardware or exposure to personnel could result.

C. Cleaning solvents and adhesive materials shall be contained in NFPA-approved safety containers. The use of and quantity allowed in the payload processing work area shall be approved by the LSSO. All users of these materials must comply with local fire, safety, and health regulations. Except where approved by the LSSO, the use of glass containers is prohibited in all payload processing work areas.

D. Use of flammable materials and static-producing materials shall be kept to a minimum in all payload processing areas. If any plastic film is to be used, the material shall be selected from the LSSO approved plastics list. The material, quantity, and location of use shall be included in the RSC-E safety data package and approved by the LSSO. If a plastic film is not on the approved list, a sample (minimum 1 square yard) shall be submitted to the LSSO for test/evaluation and approval.

E. GSE that contains components made of shatterable materials which is to be used inside the Orbiter or in areas where it could fall into the Orbiter shall be designed to provide positive containment to prevent fragments from entering the Orbiter.

F. GSE designed for use directly in the Orbiter crew cabin or payload bay must meet the same materials flammability requirements as the payload/experiment itself.

G. GSE used in flight vehicle habitable areas or in the payload bay shall not be painted or coated with materials subject to chipping, flaking, or scaling.

H. Delete

4.3.10 Industrial Hygiene

Hazardous materials and physical agents must be controlled during all phases of launch/landing site operations to protect personnel by preventing exposures in excess of applicable limits and to comply with applicable federal and state regulations and requirements.

A. Descriptive information concerning proposed uses of hazardous materials and physical agents will be provided by the payload organization to the LSSO for review and evaluation by the Biomedical Office.

B. General Industrial Hygiene requirements include, but are not limited to, the following:

1) Equipment which contains, possesses, or emits hazardous materials and/or physical agents will be designed, constructed, installed, and operated in a manner to ensure that the potential for exposure is kept as low as feasible.

2) The payload organization shall provide a list of all hazardous materials and physical agents containing names, quantities, locations, and proposed uses (reference Paragraph 3.2.I). The payload organization shall also submit to the Launch Site Support Manager (LSSM) their input for the MSDS for each of these materials 60 days before arrival at the KSC.

3) Hazardous materials and physical agents shall be used only by properly trained personnel and in accordance with procedures reviewed by the Biomedical Office and approved by the LSSO.

4) Engineering or administrative controls shall be the primary means for preventing personnel exposures. When such controls are not feasible or adequate to control exposure, personal protective equipment will be required.

5) Planned releases of hazardous materials shall not be permitted without review and approval by the LSSO and the Biomedical Office. Supportive data shall be provided by the payload organization to identify maximum expected quantities and concentrations of planned releases.

6) All activities involving hazardous materials or physical agents are subject to monitoring by the Biomedical Office.

C. Delete

4.3.11 Oxygen - Delete

4.4 ENVIRONMENTAL

4.4.1 Meteorological Requirements - Delete

4.4.2 Hazardous Atmosphere

4.4.2.1 General - Hazardous atmospheres are defined as follows:

A. Flammable/Explosive Atmospheres - Hazardous atmospheres are defined as follows: A percentage of the lower explosive limit (LEL) shall be established to define a hazardous atmosphere for flammable/explosive gases or vapors by the LSSO on a case-by-case basis. Factors such as commodity involved, quantity, confinement area, the presence of oxygen-enriched atmospheres (greater than 25%), credible time for a hazardous condition to develop, and response time to complete emergency actions must be considered in establishing the percentage of the LEL. This percentage is usually 25% of the commodity LEL.

B. Oxygen Deficient Atmospheres - A hazardous oxygen-deficient atmosphere may develop in enclosed spaces where operations or processes consume oxygen or release asphyxiating gases or vapors into the atmosphere. Entry into any atmosphere containing less than 19.5% oxygen is considered hazardous.

C. Toxic/Corrosive Atmospheres - Hazardous toxic/corrosive atmospheres may be present where processes or operations generate airborne materials. Hazardous airborne materials include dusts, fibers, mists, fogs, smokes, fumes, gases, and vapors.

4.4.2.2 Confined Space Entry - Specific technical operating procedure approved by the LSSO, is required for work in confined spaces.

4.4.2.3 Hazardous Atmosphere Areas for Electrical Equipment - The hazardous atmosphere area for ammonia servicing shall be defined as 10 feet radially from the ammonia servicing equipment or the flight hardware (SPP).

4.4.2.4 Requirements for Electrical Equipment in Hazardous Atmospheres -

4.4.2.4.1 When operated within the area prescribed in paragraph 4.4.2.3 above, electrical equipment that is operated during ammonia servicing shall be either explosionproofed for ammonia or hazardproofed. Hazardproofing may be obtained by potting, hermetically sealing, or by positive pressurization with an inert gas or clean air. This equipment must be monitored by personnel at all times during operation. This requirement does not apply to cables and their connectors on the flight hardware.

4.4.2.4.2 Electrical equipment to be operated outside the 10 foot control area shall be controlled by a single switch capable of deactivating all the nonexplosionproof equipment within the area. The switch shall be manned at all times when the equipment is in use. The switch shall be explosionproof/hazardproof if it is located within the 10 foot control area. Equipment which cannot meet this requirement shall be identified in the safety data package.

4.4.3 Humidity - Delete

4.4.4 Toxic Materials

The LSSO and Biomedical Office will establish criteria for operational controls involving all toxic materials.

4.5 HANDLING AND TRANSPORTS

The following definitions are to be used in this section:

A. Lifting devices - slings, linkage, mechanisms, etc., that extend between a lifting hook on a hoist and the object being lifted. Only those items below the lifting hook are intended to be designed to the criteria contained in this Handbook. The requirements for the design of hoists, winches, and cranes are not included.

B. Ground handling/transportation devices - trucks, dollies, transporters on which an object is placed for subsequent transportation or rotation.

C. Work stand - work platforms, ladders, etc., that are fixed structures, are designed specifically to support personnel, and do not experience the dynamic loading associated with lifting and transportation.

D. Support stand - GSE structure designed to support flight or ground equipment.

E. Rated load - the maximum static weight that the basic equipment can safely support or lift.

F. Working (actual) load - the expected or measured weight of a piece of equipment that is to be supported, lifted, or transported.

4.5.1 Hoisting and Handling

4.5.1.1 General - Delete

A. All lifting and hoisting equipment must show evidence of the equipment having been tested in compliance with the requirements of the paragraphs in this section. This must be accomplished within 1 year prior to use.

B. Records of all testing and inspections shall be maintained and shall be made available to the LSSO upon request.

C. Rated loads will be posted on all lifting and hoisting equipment and fixtures.

D. Magnetic particle, dye penetrant, radiography, or other suitable crack-detecting tests shall be performed on all load-bearing hooks, shackles, and eyebolts after the initial proof test of the assembled sling but prior to use and annually thereafter. The nondestructive inspection (NDI) method selected will require approval by the LSSO during the phase safety review process. A defect-detecting method such as radiography or ultrasonics which evaluates the material through 100% of its depth shall be performed on all welds constituting a single point of failure (i.e., critical weld) after the initial proof test of the assembled sling. Critical welds shall be eliminated where feasible. If RSC-E certifies that their lifting hardware is for a specific function, is properly controlled in terms of usage/misusage and the environment, and has undergone a thorough NDI prior to application of a protective coating, the LSSO may not require an annual NDI.

E. Thimbles, shackles, links, eyebolts, swaged fittings, wire ropes, and similar devices must be subjected to and comply with the testing, preoperational and periodic inspection, and maintenance requirements set forth in Section 4.5.1. Eyebolts which are permanently fixed to the load are to be considered exempt from proof loading and NDI requirements. However, the eyebolts must comply with the design requirements of Table 4-1.

F. Eyebolts that can be removed and replaced must have a positive means of determination of full thread engagement (i.e., shoulder, color marking, etc.).

G. Attach points to payloads for the purpose of ground handling shall be classified as either utilizing the flight structural interfaces to the Orbiter or having special attach fittings for the purpose of ground handling. When utilizing the flight attach fittings for ground handling, structural analysis shall not be required if this determination has been made for flight dynamics. When special fittings for ground handling are used, an analysis shall be conducted to ensure the load paths have adequate safety factors for ground handling. The attach points (S/C) and fittings (GSE) shall be adequately described in the safety data package, including single failure points, verification methods (e.g., proof testing, NDI), and the methods used to assure proper connection during ground handling.

H. Proof loading and associated NDI will be reaccomplished for modified or repaired lifting equipment.

I. A load will not be lifted, suspended, or transported over personnel. This requirement should be considered during design of GSE for hardware integration and assembly.

4.5.1.2 Requirements for Slings -

A. Slings shall be designed and tested as an assembled unit (unless otherwise approved by the LSSO) which includes spreader beams and drop legs (ropes, chains, shackles, eyebolts, pins, turnbuckles, etc.) in accordance with Table 4-l. Proof or periodic load test shall be accomplished within 1 year prior to use.

B. All sling assemblies shall be visually inspected each day prior to use. A periodic inspection shall be performed by the using organization on a regular basis with frequency of inspection based on frequency of sling use, severity of service conditions, nature of lifts being performed, and experience gained on the service life of slings used in similar circumstances. Periodic inspections shall be performed by an authorized person. Any deterioration which could result in appreciable loss of original strength shall be carefully noted, and determination made whether further use of the sling would constitute a safety hazard. Periodic inspections shall be conducted annually, as a minimum.

C. Wire rope slings shall be immediately removed from service if any of the following conditions are present:

1) Ten randomly distributed broken wires in one rope lay or five broken wires in one strand in one rope lay.

2) Wear or scraping of one third the original diameter of outside individual wires.

3) Kinking, crushing, bird caging, or any other damage resulting in distortion of the wire rope structure.

4) Evidence of significant heat damage.

5) End attachments that are cracked, deformed, or worn.

6) Hooks that have been opened more than 15% of the normal throat opening measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook.

7) Significant corrosion of the rope or end attachment.

Table 4-1 Sling Requirements

SLING COMPONENT	SAFETY* FACTOR (ULTIMATE:RATED)	PROOF TEST (PROOF:RATED)	PERIODIC LOAD TEST (TEST:RATED)
Wire Rope	5	2	1.25
Alloy Steel Chain	5	2	1.25
Metal Mesh	5	1.5	1.25
Natural or Synthetic Web	5	1	1
Natural or Synthetic Rope			
Manila	5***	1	1
Polypropylene	6***	1	1
Polyester	9***	1	1
Nylon	9***	1	1
Structural Members (e.g., spreader beams)	5****	2	1.25
Shackles, Turnbuckles, Eyebolts, etc.	5	2	1.25

* As relates to this table, safety factor is defined as the ratio of a load that predicts a failure to a rated load.

** Delete

*** Use of rope slings will be limited to 50% of the rated capacity (manufacturer's rating).

**** A 3:1 safety factor against the worst case failure mode that will result in local yielding is acceptable.

D. Structural sling inspection shall be performed at least annually. Discrepancies found during the following inspections shall be cause for replacement or repair:

1) Verify, overall, that there is no evidence of visual damage, gouges in metal, flaking paint, loose bolts, rivets, or connections, or deformation such as galling or gouges in pins, eyes, and end connections.

2) Ensure that there are no bent, deformed, cracked, or excessively corroded support or main members.

3) Inspect load-bearing bolts and verify that there is no visual evidence of bending, cracking, gross wear, or improper configuration.

4) Inspect attached and lifting lugs for visual deformation and evidence of local yielding.

5) Ensure that there are no elongated attach or lifting holes.

6) Inspect around fasteners for local yielding and deformation.

7) Remove and inspect load-bearing slip pins for visual deformation, evidence of bending, abnormal defects such as galling, scoring, brinelling, and diameters not within drawing tolerances. NDI shall be used when required by design requirements or when cracks are suspected.

8) Inspect pin bores visually for cracks, deformation, local yielding, scoring, galling, and brinelling. NDI shall be performed as required.

9) Inspect welds for cracks and evidence of deformation, deterioration, damage, or other defects by–

a. Visual inspection of all welds.

b. Magnetic particle, x-ray, or other suitable crack-detecting methods as appropriate for critical welds as identified on the drawings.

10) Inspect all parts, particularly bare metal, for corrosion. Corrosion-protect all surfaces that are to be painted, lubricated, or coated with strippable vinyl, as necessary. Do not paint over uninspected areas; do not paint over cracks, deformations, deterioration, or other damage until engineering assessment has been made.

E. For identification and on-site assurance purposes, equipment shall have a periodic recertification tag containing equipment identification, next required test date, and quality control stamp. Hoists/winches and slings shall have proof load tags containing rated load, proof load, and proof load date.

F. Slings which have components that are normally disassembled shall be either marked, coded, or tethered to assure proper assembly of verified hardware. Components not marked, coded, or tethered will invalidate the proof load/certification of the whole assembly. Removable lifting lugs used on flight hardware or GSE must be identified to ensure the lugs can be reinstalled in the proper location if necessary.

G. Synthetic or natural rope slings shall be derated by 50% after the proof load; this then becomes the rated load; i.e., manufacturer's rating x 1.0 (proof test factor) x 0.50 (derating factor) = posted rated load.

4.5.1.3 Hydrasets - Delete

4.5.1.4 Chainfall - Delete

4.5.1.5 Load cells - Delete

4.5.1.6 Stands -

A. Ground handling devices and support stands shall have a safety factor of 3:1 against yield.

B. Personnel work stands shall have a safety factor of 4:1 against ultimate.

C. Delete

4.5.2 Transporters- Delete

5.0 MISHAP INVESTIGATION AND REPORTING

5.1 NASA MISHAP INVESTIGATION CONTROL

Reporting and investigation for mishaps involving NASA payloads and associated GSE will be conducted.

5.2 Delete

5.3 MISHAP REPORTING

5.3.1 Mishap Contacts

The payload organization shall immediately report to the LSSO mishaps which result in death or injury/exposure of personnel or damage to resources, equipment, or facilities. Close calls shall be similarly reported. The LSSO mishap point of contact is as follows:

A. KSC Payload, Space Station and Industrial Safety Division (EI-F).

B. Delete

C. At contingency landing sites: The designated on-site LSSR.

Note: In the event that the mishap involves the release of and/or exposure to hazardous chemical agents, the Biomedical Office representative will be notified in addition to the LSSO.

D. Facility operators involved with or observing a mishap shall notify their safety point of contact.

Note: The LSSO mishap point of contact, above, is responsible for further notification to other LSSO mishap points of contact as necessary.

5.3.2 Payload Organization Involvement

RSC-E is responsible for investigating all mishaps and anomalies with which they may be involved, to the extent of their involvement.

5.3.3 Payload Organization Responsibilities

For mishaps involving RSC-E, the following defines investigation and written reporting responsibilities:

A. If government personnel/property, including contractors, are injured/damaged from or contribute to the mishap, then RSC-E shall report as follows:

1) A preliminary written report of the mishap to the LSSO mishap point of contact within one working day after the mishap occurs.

2) RSC-E may be requested to conduct its own investigation concurrently with the government investigation.

3) RSC-E will provide a copy of the final report to the LSSO mishap point of contact.

B. If only RSC-E personnel/property, including RSC-E contractors, are injured/damaged from or contribute to the mishap, and the mishap is not considered a near miss to government property/personnel, then the RSC-E shall report as follows:

1) When the LSSO mishap point of contact is notified, the need for a preliminary written report will be determined.

2) Investigation shall be done by the payload organization using its own internal procedures.

3) A copy of the final report of the mishap investigation shall be sent to the LSSO mishap point of contact for Lessons Learned purposes.

5.3.4 Investigation Boards- Delete

5.3.5 Mishap Scene.

The scene of the mishap shall not be disturbed until the investigating authority has given concurrence to do so.

APPENDIX A

ACRONYMS, ABBREVIATIONS, AND GLOSSARY OF TERMS

AC - Alternating Current.

ACGIH - American Conference of Governmental Industrial Hygienists.

AFM - Delete.

AFOSH - Delete.

AFR - Delete

AFSC - Delete

AFSCF - Delete

ANSI - Delete.

ASME - Delete

AWG - American Wire Gauge.

BUDDY SYSTEM - The buddy system requires that two people be designated to be concerned with each other's safety in a hazardous situation. The system does not demand shoulder-to-shoulder contact, but rather visual contact and a proximity that alllows each buddy to help the other in an emergency.

C - Centigrade.

CCAFS - Delete

CFR - Code of Federal Regulations.

CLOSE CALL - An unplanned occurrence in which there is no injury/damage but under similar circumstances could have resulted in a reportable mishap.

cm^2 - Centimeter Squared.

CPIA - Delete

CREDIBLE - A condition that can occur and is reasonably likely to occur. For the purpose of this document, failures of structure, pressure vessels, and pressurized lines and fittings are not considered credible failure modes if those elements comply with the applicable requirements.

CRITICAL WELD - A weld where a single failure of any portion could result in injury to personnel or damage to property or flight hardware.

DAMAGE - Breakage, mangling, mutilation, ruin of items, transmitted across system or component interfaces inadvertently by internal or external action, including component failure and human error which could cause obstruction of critical functions and requiring repair or replacements.

D.B. (DESIGN BURST PRESSURE) - A specified test pressure that pressurized components must withstand without rupture to demonstrate design adequacy in a qualification test.

dB - Decibel.

dBA - Decibel, A-scale.

DC - Direct Current.

DEVIATION - Granted use or acceptance of an article for more than one mission which does not meet the specified requirements.

DH - Delete

DOD - Delete.

DOP - Delete

EED - Electroexplosive Device.

ELS - Eastern Launch Site, including Kennedy Space Center and/or Cape Canaveral Air Force Station.

EMI - Electromagnetic Interference.

EPD - Emergency Procedures Document.

ETA - Explosive Transfer Assembly.

EXPLOSIONPROOF APPARATUS - Apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor which may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and which operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby.

F - Fahrenheit.

FAILURE - The inability of a system, subsystem, component, or part to perform its required function within specified limits, under specified conditions for a specified duration.

FLUID - Liquids or gases.

GSE (GROUND SUPPORT EQUIPMENT) - The ground equipment and systems needed to support the payload such as propellant loading units, data recording, instrumentation, etc.

HAZARD - A risk of personnel exposure, injury, or death; or of hardware damage or loss.

HAZARDPROOF - Prevention of an explosive atmosphere penetrating electrical fixtures where sparking or arcing could occur.

HAZARDOUS FLUID - Any fluid that is toxic, cryogenic, flammable, or corrosive.

HAZARDOUS MATERIAL - This includes solid, liquid, or gaseous materials which, under foreseeable conditions, are toxic, carcinogenic, cryogenic, explosive, flammable, pyrophoric, water-reactive, corrosive, an oxidizer, a compressed gas, a combustible liquid, or are chemically unstable.

HB - Handbook.

I.D. - Identification.

IMC - Interim Message Change.

IUS - Delete

JP - Delete.

JSC - Johnson Space Center, NASA, Houston, Texas 77058.

KHB - Kennedy Handbook.

KMI - Kennedy Management Instruction.

KSC - Kennedy Space Center, NASA, Florida 32899.

KSC-STD - KSC Standard.

LEL - Lower Explosive Level.

LSSO - Launch Site Safety Office.

LSSR - Launch Site Safety Representative.

mA - Milliampere.

MAWP (MAXIMUM ALLOWABLE WORKING PRESSURE) - The maximum pressure at which a component can continuously operate based on allowable stress values and functional capabilities. MAWP is synonymous with MDOP (Maximum Design Operating Pressure) or "Rated Pressure."

MDOP - Maximum Design Operating Pressure.

MIL - Delete

MIL-STD - Delete.

MISHAP - An unplanned event which results in personnel fatality, injury, or exposure; damage to or loss of the Space Shuttle, environment, public property, or private property; or could result in an unsafe situation or operational mode.

MOP (MAXIMUM OPERATING PRESSURE) - The maximum pressure at which the system or component actually operates in a particular application. MOP is synonymous with MEOP (Maximum Expected Operating Pressure) or maximum working pressure.

MPE - Maximum Permissible Exposure.

MRS - Major Radiological Sources.

MSDS - Material Safety Data Sheets.

mV - Millivolt.

mW - Milliwatt.

N/A - Not Applicable.

NASA - National Aeronautics and Space Administration.
NDI - Nondestructive Inspection.

NEC - Delete

NFPA - Delete

NHB - NASA Handbook.

NMI - NASA Management Instruction.

NONCOMPLIANCE REPORT - The request form submitted by the payload organization to obtain a waiver or deviation for those technical safety requirements of this document that have not been met.

OMD - Operations and Maintenance Documentation.

OMI - Operations and Maintenance Instructions.

OSHA - Occupational Safety and Health Administration.

PAYLOAD - Any equipment or material carried by the Space Shuttle that is not considered part of the basic Space Shuttle itself. It, therefore, includes items such as free-flying automated spacecraft, individual experiments or instruments, payload support equipment, etc. As used in this document, the term payload also includes payload-provided GSE and systems and flight and ground systems software.

PAYLOAD BAY - The 15-foot diameter by 60-foot long enclosed volume within the Orbiter, designed to carry carriers, payloads, payload-support equipment, and associated mounting hardware.

PAYLOAD ELEMENTS - Experiments, instruments, or other individual payload items which are subsets of an integrated, multipayload cargo complement on missions such as Spacelab, etc.

PO (PAYLOAD ORGANIZATION) - The funding or sponsoring organization for the experiment, payload, or mission. This does not mean the principal investigator, payload contractor, designer, or developer except to the extent delegated by the sponsoring organization. For NASA-sponsored payloads, a NASA Headquarters payload program office is the sponsoring organization and usually delegates to a NASA Field Center the authority for formal interface with the SSP operator in the implementation of this document. Other payload organizations include, but are not limited to, the following: DOD, other U.S. Government agencies, non-U.S. Government public organizations, private persons or private organizations, international organizations, European Space Agency, foreign governments, etc.

PHE - Delete.

PHYSICAL AGENT - Any environmental factor, such as noise, temperature extremes, vibrations, etc., which may cause harm or injury to personnel.

PRESSURE TEST - A test pressure which demonstrates that no part of a pressure system component shall fail, take any permanent set, or be damaged in any manner, when subjected to the applicable proof pressure.

psi - Pounds Per Square Inch.

psig - Pounds Per Square Inch Gauge.

RATED LOAD - The static weight that the basic equipment can safely support or lift.

REFEREE FLUID - A compatible fluid, other than that used during normal operation of a system, which is substituted for test purposes because it is safer due to characteristics such as being less toxic, less explosive, easier to detect, etc.

REM - Roentgen Equivalent, Man.

REQUIREMENT - A specified mandatory condition which must be complied with unless a noncompliance report is approved by the Center Commander/Director.

RF - Radio Frequency.

RH - Relative Humidity.

RHU - Radioisotope Heater Unit.

rms - Root Mean Square.

RP - Delete

RPO - Radiation Protection Officer.

RTG - Radioisotope Thermoelectric Generator.

S&A - Safe and Arm.

SAE - Delete

SAFETY CRITICAL - Any condition, event, operation, process, equipment, or system with a potential for exposing personnel to a hazardous material, injury or death, or for causing damage to, or loss of, equipment or property.

SAFETY FACTOR - The ratio of a load that predicts a failure to a rated load.

S/C - Spacecraft.

SD - Delete

SDR - Delete

SHALL - Mandatory action.

SHOULD - Recommended action.

SPIF - Delete

SPW - Delete

SPWR - Delete

SSP - Space Shuttle Program.

STD - Standard.

STS (SPACE TRANSPORTATION SYSTEM) - The Space Shuttle, Spacelab, Inertial Upper Stage (IUS), and the ground sites needed to support these elements.

SYSTEM CERTIFICATION PRESSURE - The maximum pressure that has been applied to a system; however, no system element can have its MAWP exceeded when the certification pressure has been applied.

TBD - To Be Determined.

T.O. - Delete

TOP's - Technical Operating Procedures (See Appendix C).

TP - Delete

UDS - Delete

USAF - Delete

WAIVER - Granted use or acceptance of an article for a single mission which does not meet the specified requirements.

WILL - Advising of future action.

APPENDIX B

COMPLIANCE AND REFERENCE DOCUMENTS

(DELETED)

APPENDIX C

GUIDELINES FOR THE PREPARATION OF TECHNICAL OPERATING PROCEDURES (TOP's)

1. The Safety Community applies the generic term, Technical Operating Procedures (TOP's), to all test or operations procedures. The term "TOP's" only implies that the procedure must meet minimum content and processing standards. In practice, procedures will carry the nomenclature of the system under which they are developed such as Operations and Maintenance Instructions (OMI's) of the Operations and Maintenance Documentation (OMD) system. The host organization prescribes the system to be used.

2. TOP's are categorized as follows:

   TOP's are classified as hazardous or nonhazardous in accordance with the criteria provided in Paragraph 4.1.3A of the basic document.

   a. Category I TOP: Provides detailed procedures authorizing work for the operation, maintenance, verification of ground support systems/equipment, and instructions for checkout, servicing, handling, and transportation of the payload systems/subsystems and experiments during prelaunch, launch, and postlaunch operations. Repetitive hazardous and nonhazardous operations use Category I TOP's.

   b. Category II TOP: Provides engineering instruction, authorizes work, establishes work control methods, and is normally prepared for a one-time-only nonhazardous operation in order to accommodate special tests or authorize temporary installations, removals, or replacements.

      A Category II TOP may also be used for one-time-only hazardous operations and for repetitive nonhazardous operations when work is of limited scope and does not economically justify preparation of a Category I TOP.

3. The review and approval process for TOP's is in accordance with the TOP category.

   a. Category I hazardous TOP's are submitted to the LSSO for safety approval.

   b. Delete

   c. Category II hazardous TOP's are submitted to the LSSR for approval.

   NOTE: Nonhazardous TOP's are submitted to the LSSO for review only.

4. All TOP's shall be prepared in clear, precise language that can be readily understood by personnel involved in the operations. All hazardous TOP's will be reviewed for content as follows:

   a. A brief description of the task operation or checkout.

   b. Identification of the operating location for hazardous operations (e.g., facility, building, test area, etc.) and/or departing/arriving areas [e.g., Shuttle Payload Integration Facility (SPIF), Pad 39A, etc.].

   c. Specific hazards to which personnel will be exposed during the operation (e.g., explosives, propellants, radiation, etc.). Configuration of the payload prior to, during, and at completion of operation shall be provided.

d. Identification of inhibits and a means for verifying that the inhibits are in place.

e. Identification of any condition(s) which cause the TOP to be classified hazardous. Safety precautions (CAUTION/WARNING notes) will be specified for any activities, hazardous or nonhazardous, where specific guidelines must be observed or actions taken to prevent or limit hazards. The notes will immediately precede the step/sequence which directed the action. Public address announcements, where available, will be made to alert personnel of the dangers and information associated with the hazardous operation. All procedures involving manually controlled pressurization of systems where MAWP can be reached shall contain a CAUTION/WARNING stating the MAWP immediately before the step which calls for pressurization. Definitions are–

Warning: Operational step(s), etc., which if not adhered to or observed could result in per- sonal injury or exposure.

Caution: Operational step(s), etc., which if not adhered to or observed could result in damage to equipment.

f. Identification of organizational elements and facilities required to support the operation (e.g., Safety, Security, Medical, etc.).

g. Identification of tools, equipment, and clothing required for the safe performance of a hazardous operation or as required by emergency procedures associated with the operation. Protective equipment shall be specified by manufacturer and model number. This information will be contained/specified within the "warning note" immediately preceding the first step/sequence or group of steps within a sequence which is hazardous.

h. Safety related quality assurance verifications have been identified. These include verifying calibration of monitoring equipment and gauges, load testing of lifting devices, specification of torque values, calibration of torque wrenches, etc.

i. A list of referenced documents containing all the instructions that are specifically called out within the TOP or required to support the operation. The list will contain the document identifying number, revisions, and title with the originator listed in parenthesis after the title. Where the latest issue of the document or drawing is to be used rather than a specific revision, latest issue (LI) will be entered in the revision column.

j. Unique safety rules and regulations that cannot be addressed to a specific step in the operational sequence of the TOP, but which are required for the safe conduct of a hazardous operation. Note: The final authority for the Safety Requirements Section will be the responsibility of the appropriate safety office.

k. A list identifying those essential personnel required in the specified control area during hazardous steps/sequences. The list will be included immediately preceding the first step/sequence or group of steps within a sequence which are hazardous. The list will identify the individuals by call sign/functional title, number of personnel, approximate location, function, and the organization or contractor employing the individual. Changes to this list shall be considered on a case-by-case basis with approval by the LSSR. If the list is identical throughout the TOP, it may be detailed once and referenced thereafter.

l. A procedural step (placed immediately preceding the first step/sequence of the hazardous steps) to identify/specify each control area for hazardous operations and directing all nonessential personnel to clear the specified control area, allowing sufficient time for them to do so

before the start of a hazardous step/sequence. Control areas are normally specified in the appropriate LSSO documentation or must be approved by the LSSO. Special consideration will be given to a potential release of explosive/toxic vapors. The controlled area will be determined on quantity (worst case calculation).

m. When LSSR participation is required, the following steps are included:

1) 24-hour notification prior to start of procedure.

2) LSSR concurrence prior to start of step/sequences or subtask TOP's containing hazardous operations.

3) Prior to opening the control area for controlled work at the conclusion of hazardous activities.

n. A procedural step to verify the payload organization completion of the facility safety inspection. A procedural step requiring the performance of a pretest and pretask briefings. The pretest briefing will immediately precede the beginning of the operational steps of the Technical Operating Procedure (TOP). The pretask briefings will precede each step/sequence or group of steps within a sequence which are hazardous. If a shift change occurs prior to the completion of the hazardous task, then the briefing must be repeated for the relieving employees. Items to be addressed are specific hazards personnel and equipment will be exposed to, safety protective equipment, emergency alarms, evacuation routes, emergency instructions and Emergency Procedures Documents (EPD's), the specific revisions of TOP's to be used, and identification of critical items.

o. Prior to and following each hazardous step/sequence, section, paragraph, or step within the TOP text introducing a hazardous operation(s), notes will be inserted similar to the following:

1) Prior to:

WARNING

THE FOLLOWING STEPS/SEQUENCES ARE HAZARDOUS - INSTALLATION OF CATEGORY A ORDNANCE (SPECIFY ALL HAZARDS)

2) Following:

NOTE

END OF HAZARDOUS STEPS/SEQUENCES

p. All hazardous operations require the use of the "Buddy System."

q. Identification of those job categories requiring certification/license for the performance of the TOP task, and procedural step prior to the performance of hazardous operations ensuring that personnel are properly certified, equipped, and briefed.

r. A procedural step verifying that a preroute survey has been accomplished before transporting GSE and flight hardware where length, height, or width may cause interference problems/hazards.

s. A procedural step verifying that a safety walkdown of the area involving flight hardware and/or related GSE has been performed prior to the commencement of any hazardous steps.

t. A procedural step with the task leader verifying that personnel participating in a hazardous operation are equipped, briefed, and ready to proceed.

u. Each integrated/controlling TOP must specify specific safety controls which are contained in sub-task TOP's/documents.

v. Emergency Instructions. Any TOP, hazardous or non-hazardous, must have emergency instructions when operations directed in the TOP activate systems/equipment capable of causing personnel injury or equipment damage if not expeditiously shutdown, safed, or secured should a malfunction occur (i.e., electrical, pneumatic, hydraulic, propellants or chemicals, lifting/hoisting). During those periods when individual TOP's are in progress, the emergency instruction in the TOP will take precedence for those operations under its control; however, the EPD will contain emergency instructions for other emergency situations not under direct control of an active TOP. Instructions shall:

1) Contain specific actions necessary to cope with emergency/contingency conditions and identify the individual directing the actions.

2) Address hazards unique to the operation and shall provide steps for rendering safe (e.g., propellant flow shutdown, pressure relief, safe ordnance, mission/operation abort, etc.) to protect personnel and equipment.

3) Be located in an appendix and available to the test team at all times.

5. Covers used on TOP's must be approved by the LSSO and shall meet the following requirements:

a. Covers shall contain a statement that the TOP contains hazardous operations or does not contain hazardous operations. The formatting of the cover is at the discretion of the payload organization; however, the following format is suggested:

1) In red block letters at least 3/16 inches high:

THIS DOCUMENT CONTAINS HAZARDOUS OPERATIONS

2) In black block letters at least 3/16 inches high:

THIS DOCUMENT DOES NOT CONTAIN
HAZARDOUS OPERATIONS

b. Emergency TOP's shall be so identified and should use a distinctive cover, preferably a different color.

c. The cover or title page shall contain the approval signatures as defined by the LSSO, date, and revision number.

6. TOP's changes/revisions shall be processed as follows:

a. Formal changes/revisions to existing Category I TOP's shall be reviewed, filed, and approved by the LSSO in the same manner as the original TOP.

b. Interim changes to existing Category I and II TOP's may be made providing they are made in accordance with the following:

1) Whenever there is insufficient time to make a formal change to a previously released TOP.

2) By an approved deviation or other documentation authorizing interim change(s).

3) Change shall be identified (select applicable term) as follows:

THIS CHANGE (DOES/DOES NOT) INCREASE
THE HAZARD LEVEL OF THIS DOCUMENT

c. Interim changes made to TOP's performed at KSC that add or increase a hazard, are written within a hazardous sequence, or involve the flight termination system require LSSO approval for release and use. Deviations (modifications) prepared when the LSSR is not present can be approved prior to performance by the LSSR by telephone, recorded OIS, or safety radio nets. LSSR signature on the deviation sheet is to follow as soon as possible.

d. A written approved deviation is required for changes/deviations to any section of a hazardous technical operating procedure, including out-of-sequence testing. For emergency or time critical operations, the test may continue with the deviation written after the fact provided concurrences are recorded on the net.

e. Out-of-sequence performance of nonhazardous tests, operations, sequences, or operational steps may be accomplished if the out-of-sequencing is annotated (along with time, date, and new location in order) in the TOP designating concurrence of key test/task personnel. Changes to technical work steps of Category I non-hazardous TOP will require a written, approved deviation.

f. For both hazardous and nonhazardous procedures, the writer may choose to preplan sequences that can be performed out of order. By writing the proper notes identifying these preplanned sequences, they may be performed without the requirement to write a deviation.

g. In addition to Paragraph e. above, redline changes will only be used to correct clerical errors or make pen-and-ink changes.

APPENDIX D

ORDNANCE STORAGE AND HANDLING
DATA REQUIREMENTS

(DELETED)

APPENDIX E

PAYLOAD RELATED EMERGENCY PROCEDURES DOCUMENTS AND FACILITY SAFETY PLANS

1. Delete

2. Delete

3. Delete

4. Delete

5. Delete

6. Delete

7. Delete

8. Delete

9. Delete

10. Delete

11. Delete

12. Payload Ground Operations Contract (PGOC) Emergency Procedures Plan, MDCY 1009, Revision I, Annex A (consolidates all the previously existing Emergency Procedure Plans). (SSPF ONLY)

Document references:

1. NSTS 13830, Implementation Procedure for NSTS Payloads System Safety Requirements.

2. SSP 30599, Safety Review Process, International Space Station Program.

3. United States Code of Federal Regulations, Department of Labor, Occupational Safety and Health Administration (OSHA), Part 1910.1200, Hazard Communication Standard.

4. KHB 1860.1, KSC Ionizing Radiation Program.

5. KHB 1860.2, KSC Non-Ionizing Radiation Program.

NOTE: The requirements of the above documents will be enforced per latest issue.